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FOREST PROBLEM ANALYSIS
AND
RESEARCH PROGRAM
FOR THE
MISSOURI OZARKS

BY ✓
FRANKLIN G. LIMING
FORESTER IN CHARGE

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OCTOBER 1951

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FOREST PROBLEM ANALYSIS AND RESEARCH PROGRAM

FOR THE MISSOURI OZARKS

By

Franklin G. Liming

BASIC INFORMATION AND BACKGROUND

FOREWORD

The success of any research program is greatly influenced by the extent and quality of planning that is done before the program is started. The time spent in planning usually pays big dividends in the efficiency of the work and the quality of the results obtained. An analysis of the problems to be solved is of primary importance in the systematic planning of a forest and range research program. This analysis should not only list and describe the various problems, but should also rate their importance in terms of urgency, use that may be made of the results, possibilities of solution, and facilities available for attacking the problems. To do this one must have a usable knowledge of the research organization, the capabilities of the technical staff, the research facilities available to them, pertinent information on the area and situations involved, and the type and extent of research already under way.

The material in this report is based on available published and unpublished data, opinions of many co-workers in forestry and related fields, and several years of field experience in the problem area. Because of the breadth of the field, the many ramifications of the problems, and the need for brevity and clarity of presentation, an attempt has been made to limit the material presented here to that necessary to an understanding of the overall situation and an evaluation of the problems. Later, as the need arises, similar but more detailed reports will be prepared on the various subdivisions of the over-all forest situation.

FOREST RESEARCH CENTER ORGANIZATION

The Northern Ozark Forest Research Center was established in November 1948 as a branch of the Central States Forest Experiment Station. Its establishment conforms to the pattern of decentralized research which has proved successful elsewhere. A clear understanding of this type of organization is essential in planning the research program. The main feature of decentralized research is the strategic location of coordinated branches of regional and national organizations for on-the-ground concentration of effort on problems common to a distinctive forest region or problem area irrespective of state lines or other political subdivision. In this way it is possible for specially trained research men to live in their work area, become better acquainted with local conditions and situations, devote their full time and efforts to help solve local problems and local phases of regional problems, and still have the benefits of regional and national supervision and coordination of their work.

The Research Center setup also offers greater opportunity for cooperation with local timberland owners, forest industries, and state and federal agencies. Problems of mutual interest which are best solved by a joint approach may be attacked on a cooperative basis. Formal cooperative agreements can be made with other agencies operating in the area and with timberland owners and wood-using industries interested in and in a position to conduct cooperative research. The Research Center program must be integrated with forest and range research in progress or planned by other agencies and must not duplicate work undertaken or planned in fields adequately covered by others.

To make sure the research program is geared to local needs and integrated with programs of other agencies and groups, a Technical Advisory Committee has been organized. This Committee is composed of representatives from state, federal, and private agencies; organizations having forestry interests; forest industries; and forest and range landowners. Such a committee, with a background of local experience in forestry and related fields, can call attention to problems and conditions which might otherwise be overlooked and help set up priorities for problems in the research program.

LOCAL INTERESTS IN FORESTRY

One of the most encouraging aspects of the forest situation in the Missouri Ozarks is the interest, enthusiasm, and progressive action of the various forest interests within the area. It is generally recognized that the forests are in poor condition, that the area is not self-supporting, that the local economy is no longer in harmony with land capabilities, and that these situations can be remedied.

Perhaps in no other section of the country could the forests be so abused and reduced to so low a level of productivity yet retain such a great capacity for recovery. This has been amply demonstrated by progressive private owners and on the 1.4 million acres of state and federal land in the area. Under fire control, regulated grazing, and sustained-yield management, even land considered submarginal for private ownership has shown remarkable recovery in the 18 years since the National Forest program was started in 1933.

Forest industries, leading citizens, far-sighted timberland owners, and conservation groups within the state are showing an increasing interest in proper management of the forests. Some of the forest industries, faced with a dwindling supply of raw material, have employed foresters, expanded their timber holdings, and worked toward sustained-yield management to assure a continuous supply of wood products for their mills.

The State Division of Forestry, created in 1938, has developed a modern forestry program. Despite limited financing and the size of the job to be done, substantial progress has been made. So far they have been able to reduce the area burned on the 6 million acres they have under organized fire control, give technical assistance and service to the owners of farm woodlots in 48 counties, produce about 2 million trees annually at two forest tree nurseries, and enact the State Forestry Act of 1946.

The State Extension Service has been active in forestry work for many years through the Extension Forester and the Balanced Farming Program. Recently, in response to an increasing demand for more information and leadership in forestry, two technical foresters were employed as assistant county agents to devote full time to forestry work in their counties.

The Soil Conservation Service, through its Work Unit Conservationists on Soil Conservation Districts and in cooperation with state and federal forestry agents, are helping woodland owners properly manage their timber as a part of their farm units.

The State Division of Resources and Development is taking an active part in planning for the full development and use of the state's forest resources. At present they are cooperating in a study to find the amount, location, and quality of pine timber in the state. They want to find out if it is feasible to encourage new forest industries in the area.

Further evidence of the interest of Missouri people in their forests is the creation of a full four-year course in forestry at the University of Missouri. Three classes of students have already graduated; several of these graduates are now employed as foresters in the state. In December 1950, after only four and one-half years, the school was accredited by the Society of American Foresters. In spite of the heavy teaching load and limited finances, a good start has been made toward developing a research program.

The establishment of the Northern Ozark Forest Research Center, a branch of the Central States Forest Experiment Station with responsibility for federal forest research in the area, is another forward step in forestry.

All of these activities and programs are important and should be expanded and strengthened. If progress in forestry is to continue, it is important that an adequate program of forest research be developed as soon as possible to provide the technical bases for the rehabilitation and wise use of the forest resource.

AREA SERVED BY THE NORTHERN OZARK FOREST RESEARCH CENTER

The research work of the Northern Ozark Forest Research Center, except for research on forestation of spoil-banks in the Western Interior Coal Province which will be discussed later, will be concentrated in the Ozark and Ozark Border Region of Missouri (see map, page 5). This region makes up about one-half of the state of Missouri and about 80 percent of the forested area in the state. It is a good example of a "distinctive forest region," or "problem area," mentioned above, with a myriad of problems, all of the same general type but varying in intensity and importance with local conditions and circumstances.

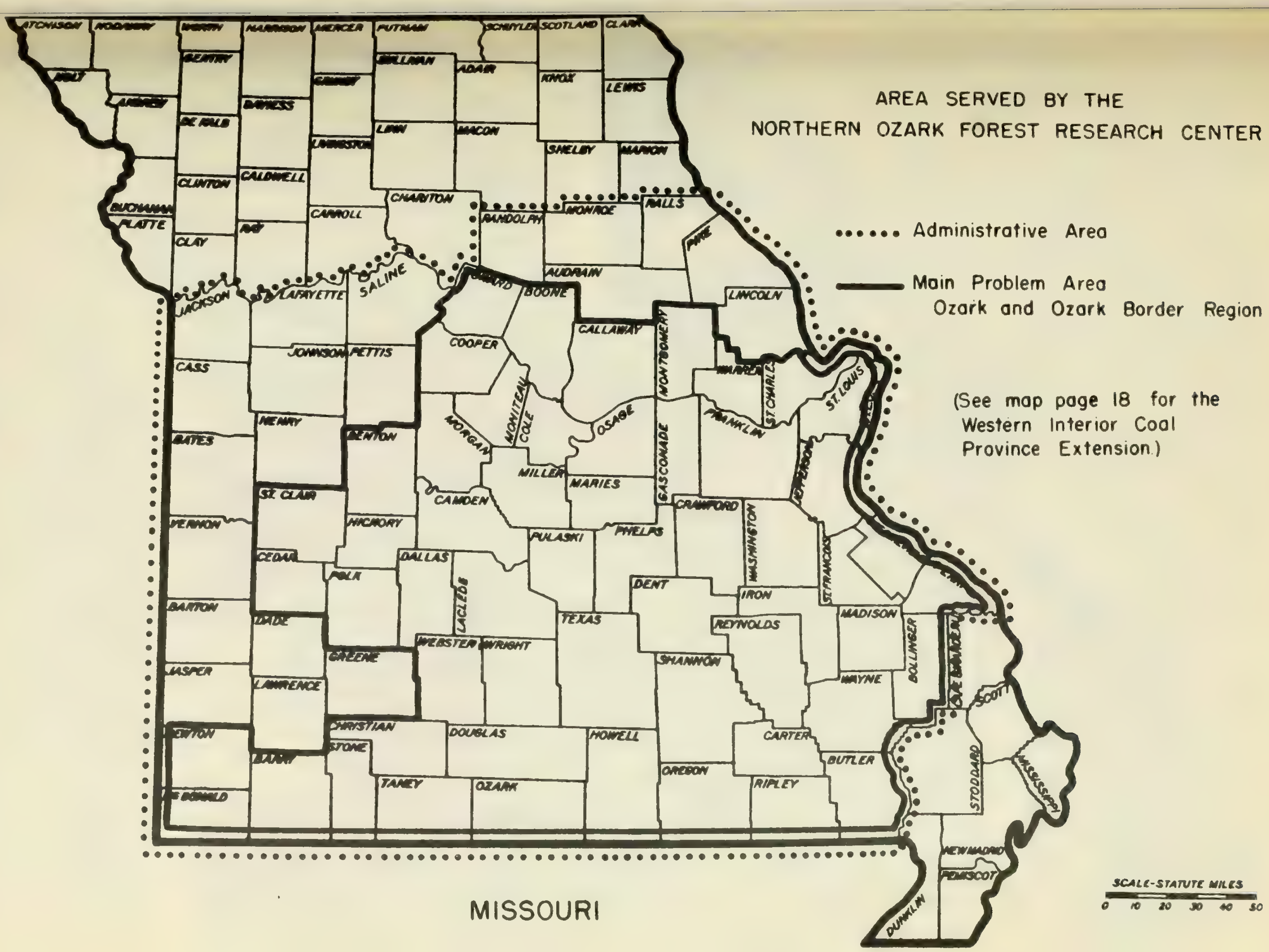
The remaining forest area consists largely of farm woodlands scattered throughout the prairie region and a smaller area of bottomland forests along the main rivers. The exclusion of these areas from the region served by this Center does not in any way minimize their importance or mean that they will not receive adequate consideration by federal and other research organizations. In fact, another branch of the Central States Forest Experiment Station at Ames, Iowa, is specializing in farm woodland research in Iowa and Northern Missouri. Still another branch at Carbondale, Illinois, includes bottomland forest research in its program. This division of responsibility is in line with the principle of establishing specific organizations to work in distinctive forest regions.

For administrative purposes and for the sake of simplicity, the boundaries of the region served by the Northern Ozark Forest Research Center were established as shown on the map, page 5. This area includes some prairie and bottomland areas but, unless otherwise indicated, the rest of this report will deal exclusively with the Ozark and Ozark Border Region, shown on the maps on pages 5 and 7.

GENERAL DESCRIPTION OF THE OZARK AND OZARK BORDER REGION OF MISSOURI

Geology and Soils

The Ozark Region is one of the oldest geologic areas in the country. For the most part it is a deeply dissected plateau remarkably uniform in physical features of topography, geology, and soils. The dominantly hilly topography consists of narrow

AREA SERVED BY THE
NORTHERN OZARK FOREST RESEARCH CENTER
•••••• Administrative Area
▬ Main Problem Area
Ozark and Ozark Border Region
(See map page 18 for the
Western Interior Coal
Province Extension.)
ATCHISON
NODAWAY
WORTH
HARRISON
MERCER
PUTNAM
SCHUYLER
SCOTLAND
CLARK
HOLT
GENTRY
SULLIVAN
ADAIR
KNOX
LEWIS
ANDREW
GRUNDY
DAVIESS
DE KALB
LINN
MACON
LIVINGSTON
SHELBY
MARION
CLINTON
CALDWELL
BUCHANAN
PLATTE
CHARITON
RANDOLPH
MONROE
RALLS
CARROLL
RAY
CLAY
PIKE
AUDRAIN
SALINE
LAFAYETTE
JACKSON
HOWARD
BOONE
LINCOLN
CALLAWAY
MONTGOMERY
COOPER
JOHNSON
PETTIS
CASS
WARREN
ST. CHARLES
ST. LOUIS
MONITEAU
COLE
OSAGE
MORGAN
GASCONADE
FRANKLIN
HENRY
BENTON
BATES
JEFFERSON
MILLER
MARIES
CAMDEN
ST. CLAIR
CRAWFORD
WASHINGTON
HICKORY
VERNON
PULASKI
PHELPS
DALLAS
CEDAR
POLK
ST. FRANCOIS
LACLEDE
DENT
IRON
MADISON
BARTON
DADE
TEXAS
REYNOLDS
WEBSTER
WRIGHT
BOLLINGER
CAPE GIRARDEAU
GREENE
SHANNON
JASPER
LAWRENCE
WAYNE
SCOTT
CHRISTIAN
DOUGLAS
HOWELL
CARTER
EWTON
STONE
BARRY
BUTLER
OREGON
RIPLEY
TANEY
OZARK
STODDARD
MISSISSIPPI
E DONALD
NEW MADRID
PEMISCOT
DUNKLIN
SCALE-STATUTE MILES
0 10 20 30 40 50
MISSOURI

valleys, steep slopes, narrow ridges, and gently rolling to level plateaus. The more level areas are limited largely to the major divides, and the steeper slopes are located along the larger streams. In the rougher area the valleys are often as much as 700 feet below the adjacent ridge tops. It is estimated that land with slopes of 20 degrees or more makes up about half of the total area. The elevation ranges from about three hundred feet above sea level in the valleys in the southeastern part of the region to about 1,800 feet at Taum Sauk Mountain, Iron County, the highest point in the state.

The rocks of the Ozark Region range from Cambrian to Pennsylvanian in age. Granite is the surface rock in much of Iron, Madison, and St. Francois Counties. Impure magnesium limestones and thin-bedded sandstone of Ordovician age prevail over most of the Ozark Region. Cherty limestones of the Mississippian age occur in the western Ozark Border. The nearly universal occurrence of chert in the soil is one of the most characteristic features of the entire region. In many places the soil may consist of 75 percent or more chert rock.

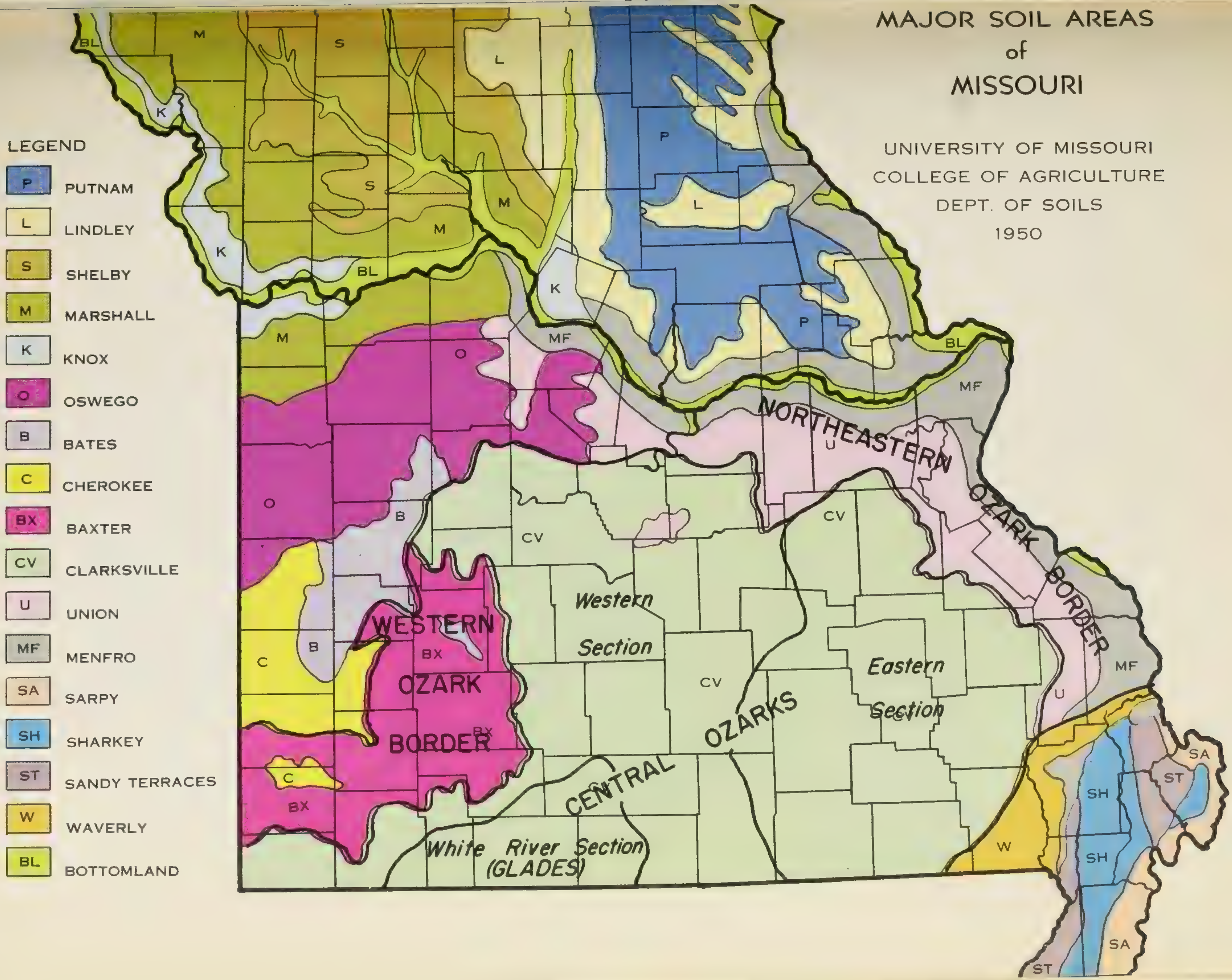
The soils of the Ozark Region are geologically old and have weathered to great depth. Moreover, the soil-forming material was generally low in plant nutrients, so that the soils were "born poor." Repeated burning has prevented organic material from accumulating, and erosion and leaching have kept the mineral nutrients at a low level. By and large, the soils are shallow and have a low productive capacity.

The soils of the Ozark Region have been grouped into four general soil areas 1/ on the basis of color, stone content, and character of soil-forming material, as shown on the map, "Major Soil Areas of Missouri," page 7.

1/ H. H. Krusekopf. "Soil Resources," Chapter 3 of Missouri, its resources people and institutions. Published by the Curators of the University of Missouri, Columbia, Mo. 1950.

MAJOR SOIL AREAS of MISSOURI

UNIVERSITY OF MISSOURI
COLLEGE OF AGRICULTURE
DEPT. OF SOILS
1950



These soil areas and their general geographic location are as follows:

Soil Area	Geographic Location
Clarksville	Central Ozarks Eastern Section Western Section White River Section
Baxter	Western Ozark Border
Menfro	Missouri-Mississippi River Hills and part of the Northeastern Ozark Border
Union	Northeastern Ozark Border

The Clarksville soil area forms the largest and the most characteristic part of the Ozarks. In the main features of color, texture, fertility, and presence of chert rock, the soils are quite similar. The surface soil is dominantly a gray to light brown silt loam, changing at a depth of about 6 inches to a gray-brown silt loam. The subsoil, beginning almost consistently at a depth of 12 inches, is a friable yellow-brown silty clay. The lower subsoil varies from "pan-like," brittle, gray silt loam on the more nearly level areas to a reddish brown clay loam on the slopes. Practically all of the soils contain chert rock. It is most abundant on the steep and south slopes. The soils are inherently of low fertility and acid in reaction. Because of their physical structure, they are slowly permeable to water and have a low water-holding capacity. Low fertility, together with steep topography and high rock content, limits the use of the land for most crops.

Most of the area was originally forested. Many of the valleys and broad ridges have been cleared for cultivated crops and pasture. Some of the cleared land, particularly on the stony slopes, has been abandoned after a few years of use and has reverted to forests. By and large, the Clarksville soil area is the forest land of the Ozarks.

The large Clarksville soil area can be divided into three subsections, primarily on the basis of forest cover and productivity. The eastern section is the most rugged part of the Ozark Region and is characterized by very stony soils and rough topography. It is the most heavily forested section and contains the majority of the shortleaf pine stands. A variation in this section is the granite hills area in Iron and adjacent counties. The soils here are shallower and generally less productive.

The western section is for the most part hilly but includes large, relatively level plateaus, or divides. The largest of these are in Dent, Laclede, and Webster Counties. They are commonly referred to as 'post oak flats." The soil is characterized by a definite hardpan at a depth of about 30 inches. The flats are some of the least productive forest land in the region. Within the lower Gasconade and Osage drainage basin there are many steep slopes with a shallow soil mantle. Much of this land supports low value stands of blackjack and post oak and, like the post oak flats, is relatively unproductive.

The White River section in the southwestern part of the Ozark Region is characterized by the so-called "glades." These are slopes where bedrock (Jefferson City limestone) is at the surface and the soil mantle is generally less than one or two feet thick. The vegetation is prairie grass, cedar, and scrub hardwoods. The glades are the best natural grazing lands in the Ozarks. The land in the valleys below the glades and on the higher elevations or ridges, where the soils are formed from the very cherty Burlington (Mississippian) limestone, is capable of supporting good stands of hardwood forest.

The Baxter soil area makes up the western Ozark Border. The surface soils range in color from gray-brown to reddish brown. The subsoils are red to yellow-brown, friable, silty clay loams. The soils are derived from chert-bearing Mississippian limestone and contain a high proportion of chert rock, particularly on the steeper areas. The surface soils average 8 to 12 inches in depth. The area is rolling to moderately hilly and has a higher productive capacity than the central Ozarks. The land was originally forested except for prairie "openings" which have darker, more fertile soil with fewer rocks. Although most of the nearly level land is cultivated, the main economy has shifted to dairying and stock raising. The territory around Springfield is now one of the greatest milk-producing centers in the country.

The Menfro soil area is a band of loess-covered hills 5 to 25 miles wide bordering the Mississippi and Missouri Rivers. It is a distinct soil area commonly known as the "River Hills" and with the Union soil area makes up the northeastern Ozark Border. The loess mantle varies in depth from 10 to 40 feet on the river bluffs to only a few inches farther from the river. The surface soils are deep, brown in color, and silty in texture. The subsoils are open and friable and, except for a larger clay content, are similar to the surface soils. The soils are inherently fertile but productivity may be low because of low organic matter content. It would be a good, small-type farming area if it were not for the hilly to steep topography and the highly erosive character of the soil. This area contains some of the best hardwood forest sites in the region.

The Union soil area is a hilly, ill-defined, transition zone between the loess-covered hills along the Mississippi and Missouri Rivers and the light colored soils of the central Ozarks. It is an area of sharp local contrast. The soil mantle on the ridges and in the valleys is deep and chert-free, whereas the soils on the slopes are thin and cherty with frequent rock out-crops. Most of the soils are derived from loessial material but some are derived from limestone and are similar to those in the central Ozarks. The stone-free soils are light brown in color and silty in texture on the surface with a reddish brown, silty clay subsoil. These soils are fairly fertile and were among the first to be used by the early settlers. Like the Menfro soils, they are hilly and subject to severe erosion but are good hardwood forest sites.

Climate

The Ozarks have a moderate, continental climate as might be expected from the location. The weather is quite changeable, particularly in the winter and summer. Extremes of hot and cold, drought and moisture, occur in some years but they are usually of short duration. The winters are somewhat milder than in the nearby prairie and plains. The average January temperature ranges from 30 to 38 degrees. Cold spells with temperatures below zero occur occasionally but they usually last only a few days. Almost every winter has long periods of mild weather. The summers are generally warm. There is a large range in temperatures, but extreme hot periods are usually short. The average July temperature ranges from 76 to 80 degrees. The frost-free period ranges from 170 to 200 days. The falls and springs are usually moderate and are by far the "favorite" seasons of the year.

The annual precipitation averages 40 to 50 inches and is almost entirely in the form of rain. Over half of it occurs from April to September. In spite of this amount of rainfall sites are relatively dry because of the rough terrain, low organic content of soil, excessive run-off and subsurface drainage, high evaporation rate, and poor distribution of rainfall. Periodically, especially during the summer months, successive periods without rain accompanied by high temperatures and drying winds result in severe droughts. These droughts are less harmful to trees than other crops because most of the tree growth occurs in the spring and early summer when the water supply is usually adequate.

People

The area has a high rural population. Most of the older people or their parents settled in the area during the booming timber business in the late 1800's and early 1900's and have a background of woods work. When the virgin timber was cut out and the large timber industries moved on to more fertile fields, many of the people began farming and livestock raising to supplement their meager incomes from curtailed timber operations. Although they were left with a reduced income and a low standard of living, they stayed on "their land." Most of them had neither the means nor the inclination to look for something better elsewhere. Except for fluctuation during emergencies, the population has not changed greatly during the last half century and it can be expected to remain about the same in the future. Although some of the people are not needed in the area under present conditions, the situation will be different when timber production is increased and a continuous supply of wood products is assured. They will then be needed to harvest the timber and man new, local wood-using industries. These industries, by making greater local use of the timber, will keep more of the profits in the local community and state.

The switch from a timber to a farming and livestock economy resulted in a land-use conflict which has prevented the full use of the resources of the area. In order to survive, they had to cut immature trees from the forests, overcrop the good tillable land, clear land unsuited for cultivation, and burn the forests to keep them from killing the forage needed for the livestock. The over-all income was too low to permit needed soil-building practices on the good tillable lands and the yields gradually decreased. Much of the cleared land was abandoned after a few years of use because of low productivity. Much of it reverted to a forest cover only to be cleared again before a timber crop could be harvested. Burning the forests provided a temporary source of forage which deteriorated with each successive burning until it was of questionable value. This burning of the forests, together with the cutting of trees as soon as they reached merchantable size, further deteriorated the forests and kept them from producing a worth-while crop.

Many of the people in this area have been going around in this vicious circle ever since the original timber crop was cut. Although this situation is bad, it is not hopeless. Some progressive, far-sighted individuals, usually with the help of some conservation agency, have broken the circle, improved the resources, and achieved a creditable standard of living. So far this progress has been most pronounced in the more productive sections of the region and state where research, service, and production agencies have been more active. As these services are increased and extended into new areas, the rate of progress should also increase.

Farming and Stock Raising

Something less than 10 of the 22 million acres in this region are devoted to pasture, hay, small grains, and, to a lesser extent, row crops and such specialty crops as grapes and strawberries.

Most of the land used in this way is in small units on ridge tops and gentle upper slopes and in narrow valleys.

Except for the few prairie-like peninsulas which extend into the region from the north and northwest, most of the region was once forested. "Clearing the land" and "fighting the sprouts" are tedious and continuing jobs. The extensive use of burning and "goating" as clearing tools often results in considerable erosion and loss in soil fertility even before the first crop is planted. The rough terrain, the low fertility of the thin, stony soils, and the hot, dry summers make it a poor farming area. Although some progressive individuals have developed creditable farms, much of the land, especially in the central Ozarks, is abandoned after a few years of cropping because of low yields and a losing battle with the sprouts.

About 70 percent of the land in the Ozark Region is classified as "land in farms" by the U. S. Census of Agriculture for 1945. The average farm includes 150 acres consisting of 60 acres of forest and 90 acres of cleared land. Most of the cash income from the farms is from livestock and livestock products.

If properly managed, the cleared land on the average farm will provide feed and forage for the farmer's livestock, but there are many exceptions. Most of the farmers who do not have enough cleared land or who do not have their cleared land fenced turn their cattle and hogs out on the unfenced land of other farmers, public agencies, or absentee owners for at least a part of the year. The practice of grazing on outside lands, usually without payment to or consent of the landowner, is most common in the rougher sections of the Ozarks where the cleared land is in small, isolated tracts. In fact, most of the areas where "open" or "free" range use is still legal are in the rough, heavily forested localities where the agricultural possibilities are poor In such areas forest residents will undoubtedly continue to depend on the open range for a major part of their income, at least until the productivity of the forests is greatly increased.

In areas where the opportunities for developing improved pasture are better and where the proportion of cleared to uncleared land is relatively high, the cleared land will provide the major part of the farm income even after the productivity of the forests is restored. At present only a small part of the cleared farm land is being used to full capacity. Yet there are many examples where improved farming and soil building practices have increased the yields from cleared lands by from two to four times. The standard of living of Ozark farmers could be greatly improved by proper management of more of the land. However, in the Ozark Region the first cost of soil improvements is usually high As a result, the cost, as well as the farmer's natural resistance to change and his lack of information on or faith in improved farming practices, slows the spread of improved farming methods.

Although progress is slow, the programs of the Agriculture Experiment Station and the Extension Service of the University of Missouri aimed at improving farming and stock-raising practices are meeting with some success in this region. During recent years, particularly in the better farming sections, there has been a gradual shift from native to improved pastures, from winter grazing to supplemental winter feeding, from beef to dairy stock, from scrub to improved stock, and from open to closed range. Although these changes are gradually reducing the pressure for use of the forest range, there are still many people who get an important part of their living from livestock foraged in the forested area.

The Forest Resource

Approximately 55 percent of the Ozark and Ozark Border Regions, or a little over 12.2 million acres, are now forested. This forested area is several times larger than that devoted to any other crop. For the most part this large forest area exists because the natives failed to remove the forests, not because they wanted to keep the area in forests. As a result, the forests are located on the rougher lands and have been grossly misused. The total area of forest has remained fairly constant during the last quarter century and can be expected to remain about the same for the foreseeable future.

About 90 percent of the forest land in the region is privately owned. Public land consists of about 1.3 million acres in national forests and other federally owned land and about 150 thousand acres in state forests and parks. A little less than one-half of the private forest land is farmer-owned and is in tracts averaging about 60 acres. A few large tracts are owned by industrial companies and the rest are owned by non-farm and non-industrial owners, many of whom are non-residents. Although the public agencies and some of the larger private owners are purchasing additional forest land, the general pattern of ownership is not expected to change materially in the near future.

The oaks are the predominant species in the region. They occur in all of the four important forest types and on most sites. The oak-hickory type, which is in fact mostly oak, makes up more than three-fourths of the forests and occurs in all parts of the region. Black oak, scarlet oak, white oak, and post oak are the principal species in this type. Shortleaf pine, red oak, hickory, and blackjack oak are also fairly abundant. The proportion of each species in individual stands varies considerably. One or two species are often present in sufficient number to warrant delineation of sub-types, such as the white oak type on the better and more moist sites, and the blackjack-post oak type on the drier and poorer sites.

Oak-pine, pine, and cedar-hardwoods are the other more important forest types which occur in the region. They are much more limited in area and distribution than the oak-hickory type. The oak-pine type is essentially oak-hickory type plus shortleaf pine. The pine type is similar to the oak-pine type but contains a greater proportion of shortleaf pine. The occurrence of these two types is limited to the southeastern half of the region and largely to the drainages of rivers flowing to the south. Most of the pine stands are in the eastern Ozark section, centering in and around Shannon, Reynolds, and Carter Counties. The pine types originally occupied a much greater area than they do now. The present pine range extends over about one-half of the region and perhaps in the future pine stands will and should become more prevalent, particularly on the more exposed sites.

The cedar-hardwood type is concentrated in the White River Drainage in the southwestern part of the region. It is also found in St. Francois and adjacent counties and on the river breaks along the Missouri River. Within these areas this type is becoming more prevalent where burning has been discontinued. The associated species are those of the oak-hickory type and elm.

The volume of merchantable timber in the region is estimated at 8.7 billion board feet. Although this is a sizeable amount of timber, it represents an average of only about 700 board feet per acre, which is extremely low. This volume is in scattered remnants of virgin stands which contain a high percent of cull and in small second-growth trees which have recently reached merchantable size. It is estimated that approximately one-third of the gross volume of merchantable-sized trees in the present stands is not now and will never be merchantable by present standards of utilization because of defect and species.

Although the stocking of the merchantable-sized trees is critically low, the stocking of the second-growth sapling and pole-sized trees is more encouraging. These trees and the existing reproduction will provide the basis for forestry for the next half century. About three-fourths of these young stands are well enough stocked so that their productivity can be restored in a reasonable period by proper management without artificially introducing new trees. The trees in these young stands have grown during a period of misuse and are quite defective and some may not produce merchantable products. The composition also deteriorated during this period of misuse. The proportions of trees of the more desirable species in the present stands are lower than they were in the original stands and certainly lower than they should be in most of the stands in the future. This is particularly true of shortleaf pine.

The timber in this region is growing at the rate of about 500 million board feet per year, an average of about 40 board feet per acre per year. This is a relatively low yield yet it represents a growth of a little less than 6 percent, based on the total merchantable volume. The timber is being cut about as fast as it is growing; so the total volume of timber is remaining about the same or increasing slightly. It should be remembered, however, that this level of productivity is only about one-fifth to one-third of the potential for the region and, because of the general practice of cutting the best timber first, the quality of the remaining timber is gradually getting worse. This is particularly important in view of the fact that the state of Missouri now imports about 65 percent of the lumber it uses.

Forest-Products Industries

Most of the timber cut in this area is used for lumber. A sizeable amount is used for railroad ties, cooperage stock, and fuel wood. A much smaller amount is used for veneer, handle bolts, posts, mine timber, and specialty products. The 2,000 sawmills in the region are capable of producing a much greater volume and a much higher quality of lumber. About 45 percent of the mills cut less than 50 thousand board feet per year. Slightly over half of them cut between 50 and 500 thousand board feet per year. This group of mills cuts about two-thirds of all lumber produced. Less than 5 percent of the mills cut 500 thousand or more board feet per year.

Many of the smaller sawmills are underpowered, undermanned, poorly equipment, and inefficient. As could be expected, they do not always make the best use of the logs, and the lumber produced is not always properly sawn. Most of the lumber is used locally or sold mill-run at the mill; as a result, very little material is graded or properly stacked for drying at the mill. There are, however, enough good, efficient, full-time mills in the area to demonstrate the feasibility of setting up good sawmill operations.

A large proportion of the railroad ties are produced by these mills, although some are produced by "tie hacking." Most of the ties are cut to definite specifications and are sold by grade. Much of the lumber now produced in the region is a byproduct of tie production.

The stave and header mills could produce a greater annual volume of material if they operated the year-round. Most of the mills are owned or operated by distilleries or have their entire output contracted to them. By and large, these mills are well equipped and efficiently operated while they are running.

Markets for fuel wood, posts, poles, mine timbers, handle bolts, veneer logs, and specialty products are rather meager, spotty, and undependable. These and many other potential outlets for timber are inadequate for complete and wise use of all timber produced in the region.

Most of the secondary wood-using industries--the industries which re-manufacture such things as lumber, bolts, rough staves, and dimension stock into finished products--are concentrated in the larger cities, such as St. Louis, Kansas City, St. Joseph, Springfield, and Joplin. In recent years there has been a definite trend to decentralize some of these industries. This is resulting in more business in local communities, more local employment, and more of the profits staying in the community in which the lumber is produced.

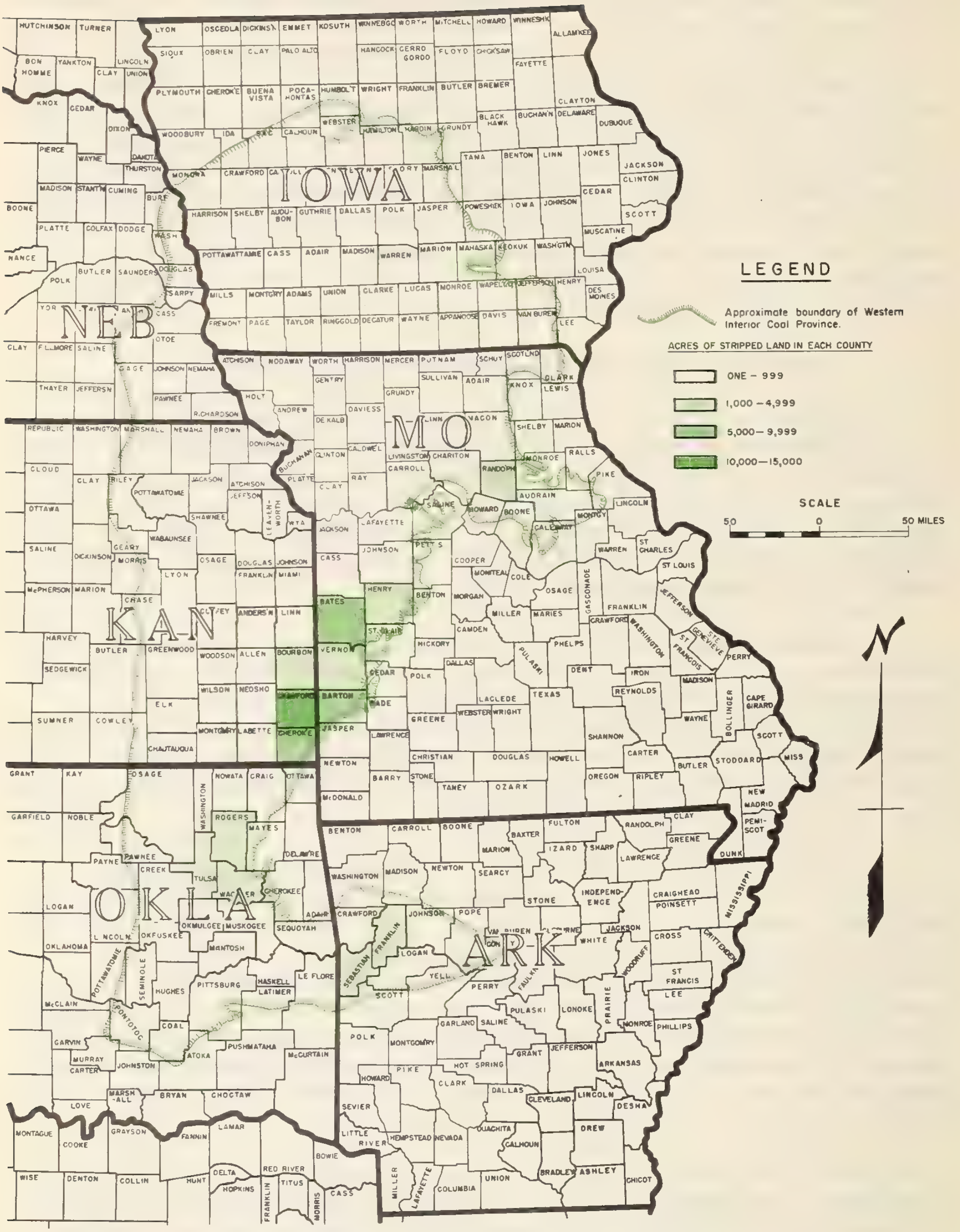
GENERAL DESCRIPTION OF LANDS STRIP MINED FOR COAL

Federal research in forestation of lands strip mined for coal in the Western Interior Coal Province is handled by the Northern Ozark Forest Research Center. This area includes parts of Missouri, Kansas, Oklahoma, Iowa, and Arkansas (see map, page 18). About 75,000 acres have been stripped to remove the underlying coal and this area is increasing at an estimated rate of 3,000 acres per year.

Approximately 30,000 acres--40 percent of this stripped land--are in 13 counties in Missouri, and about 29,000 acres are in 9 counties in Kansas. Smaller amounts are located in 12 counties in Oklahoma, 6 counties in Arkansas, and 6 counties in Iowa. About one-half of the total area stripped is in three counties--Crawford and Cherokee, Kansas, and Barton, Missouri--along the Missouri-Kansas state line.

In strip mining, the coal is removed after the soil and rock on top of the coal are removed in successive strips forty to eighty feet wide. All of the soil and rock above the coal is moved with large power equipment and dumped into a series of nearly parallel ridges or banks composed of a mixture of all the material in the strata above the coal seam. The material in these banks varies greatly in chemical and physical composition, particularly in texture, acidity, and proportion of soil-sized material. Most of the banks contain enough mineral nutrients for plant growth but are low in nitrogen and organic matter.

Most of this strip-mined land is now idle and should be restored to some productive use. Although about half of the banks are now bare, all but an estimated 4,000 acres, which are highly acid, will support a plant cover of some kind within a few years after stripping. The rough topography, high proportion of stone,


IOWA
NEB
MO
KAN
OKLA
ARK
LEGEND
Approximate boundary of Western Interior Coal Province.
ACRES OF STRIPPED LAND IN EACH COUNTY
ONE – 999
1,000 – 4,999
5,000 – 9,999
10,000 – 15,000
SCALE
50
0
50 MILES
N

The Western Interior Coal Province

and difficulty of traveling over the area are definite drawbacks to most uses. Forest and range uses are not so adversely affected by these factors, as demonstrated by successful plantations and pastures already established. These two uses offer good possibilities of restoring the productivity of large areas of these banks.

PROBLEMS

INTRODUCTION

The forest, range, and related problems in this area are so numerous, diversified, and interdependent that they may be grouped in many ways, each having its own advantages and disadvantages. In this report they will be discussed under the following headings:

1. Land-Use Classification
2. Protection
3. Forest Management
4. Range Management

It should be remembered, however, that these are not clear-cut subdivisions; there is much overlapping. One group of problems should not be considered independently of the others.

Since the main objective of presenting and analyzing the problems is to provide bases for setting up priorities and planning a program of research, these four general requirements of a research program should be borne in mind when the problems are being considered:

1. The research program must be well-balanced, coordinated not only within itself but with other work in forestry and related fields already under way in the area.

2. First work must come first. Since all problems cannot be solved at once, highest priority must be given to the greatest obstacles to rehabilitation, good management, and wise use of the resources.

3. The research work must be practical. It must provide information that will enable the landowner or manager to determine which system of management, when applied to his own land, will yield the greatest return.

4. The program must provide for prompt publication and dissemination of research results and for practical

demonstration of the solutions to important problems in the territory. The owner or manager must have a place where he can see good forestry and range management in practice under conditions similar to his own; a place where he can talk with the men who did the work and get first-hand information on methods, costs and returns, and use of equipment, and general advice and guidance in handling his forest and range land.

LAND-USE CLASSIFICATION

Classification of land as to its best use is an important problem in forest and range management in this area. Much of the land in the Ozark and Ozark Border Regions can be classified fairly satisfactorily on the basis of available information. For example, it is generally agreed that forestry is the best long-time use for most of the 12.2 million acres now in forests and possibly for a considerable area of cleared land. It is likewise agreed that grazing is probably the best long-time use for the half million or so acres of "glade" and glade-like land concentrated for the most part in the southwestern part of the area. There are, however, other areas on which either of these uses, some other use, or some combination of uses may best suit the capabilities of the land and best meet the needs of the people.

The main land-use classification problems have to do with the so-called "marginal lands" about which there is no general agreement. The present practice of switching back and forth from one use to another, particularly forest and non-forest use, results in low productivity for all uses. Before these lands can be properly classified and land use stablized, it will be necessary to determine for each use or combination of uses the cost of establishing and maintaining a crop, the quantity and quality of yields that can be obtained, the net income under different levels of management, local needs for a sound economy, the suitability of the soil, the long-time effect on soil productivity, and the effects on water relations. Since (1) establishing a good forest cover is expensive, (2) it takes a number of years to reach full productivity, and (3) once it is established it is very hard to eliminate, it is particularly important that sound decisions be made as to which lands should be in forests so that shifts to and from other uses can be kept at a minimum.

The needs of the people in the area are primarily responsible for the uses now being made of the land and will, of necessity, influence and perhaps dictate the use of much of the so-called marginal lands in the near future. Many families in the area once made their living from the forests and were left with a reduced income when the main timber supply was exhausted. They are essentially a woods-working people and will be needed in the area when the productivity of the forests is restored. Meanwhile, they are raising livestock, many of which graze in the forests, and cultivating the soil for a part of their living. Where needed, these sources of income should be maintained, and perhaps increased, at least until the forests can again contribute their share to the economy of the area. Full and wise use of the bare lands will relieve the pressure on the forests that has resulted in their misuse and low productivity. This, together with good forest management as determined by a sound research program, will hasten the development of a stable economy and a better standard of living in the area.

PROTECTION

Adequate protection of the forest and range resources is prerequisite to good management. The problems of protection against uncontrolled burning, insects, and diseases are discussed in this section. The problems of protection against unwise cutting and overgrazing will be discussed under the headings "Forest Management" and "Range Management."

Uncontrolled Burning[2]

Periodic and indiscriminate "burning the woods" became a well-entrenched custom in the Ozarks during the past half century. The reasons for burning vary from malicious intent to sincere belief that burning is beneficial. Regardless of the benefits claimed for burning, the fact remains that uncontrolled burning does untold damage to the timber, the forage, and the watershed. Such burning has been a major cause of the depleted condition of the forest and range resources.

The National Forests, the State Division of Forestry, and a few private owners have made great progress in developing fire-fighting methods and techniques and in reducing the number and size of fires on about 8 million acres in established protection districts. About 5 million acres are still in need of organized protection. Although uncontrolled burning on state, federal, and private lands has been materially reduced during recent years, fire is still a serious obstacle to good forest and range management in the region.

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[2] A detailed analysis of the problems associated with uncontrolled burning is now being written and should be ready for distribution early next year.

The problems of fire control are many and complex. They are perhaps more closely tied in with the people and land use than any other group of problems. Since most of the fires are man-caused, the goal should be to eliminate the desire or incentive to burn. The custom of periodic burning is so well-established that many years will be required to bring this about. In the meantime the area burned can be reduced by expanding organized fire-fighting activities.

Fire problems logically fall into three main groups--prevention, suppression, and effects of burning.

Prevention

The problems of preventing the setting of fires are a real challenge. To understand these problems and plan their solution, it is first necessary to understand the people and why they burn. The reasons for burning are many and varied but can be logically put into three main groups:

1. Many fires are set in the sincere belief that they keep down the brush, provide early spring pasture, kill ticks, chiggers, snakes, and predatory animals, and make the woods easier to work in and travel through. This group presents the greatest challenge in that it includes most of the fires and offers the greatest possibilities for decreasing the area burned.

2. Some fires are accidental or are set for no particular reason other than to see the woods burn and smell the smoke, or because their parents before them always burned the woods.

3. A few other fires are set with malicious intent--to get even with or irritate their neighbors, the game warden, or the state and federal fire control personnel--or to provide jobs.

To reduce the number of fires set by those who honestly believe the forests should be burned, information on the effects of fires must be provided and they must be shown their objectives can be obtained without destructive burning. In other words, it will have to be proven to them that some other course of action is better, for them, than the one they are following.

Since so many people believe that burning is beneficial, there must be, from their point of view, some logical basis for burning. It is important that those responsible for fire control work understand the points of view of those who burn and keep them firmly in mind when planning prevention programs. Of all the reasons given for burning, burning to keep the brush or sprouts from killing out the grass and other forage plants is the one most frequently given and perhaps the most plausible one. It reflects a definite conflict in land use.

From the time of the first settlement in the area, timber has been considered as something to get rid of either for cash or to make room for some other use of the land. After the main crop of timber was harvested about the turn of the century, the prospects for income from the remaining stands immediately or in the near future looked very slim. The unmerchantable trees and the reproduction or "brush" interfered with other uses of the land, particularly grazing. The attitude "The timber is no good so why not grow grass" became prevalent over most of the area. Livestock owners soon realized that burning was, for them, the easiest and cheapest way to keep the brush and leaves from killing the grass which they could use for an immediate income by grazing livestock.

Much of the land was held by absentee owners, very few people were interested in growing timber as a crop, and few recognized the value of the cover for watershed protection; as a result, those who had no direct reason for burning did not object when their neighbors burned the woods. It is easy to understand how those who had to obtain a part or all of their income from livestock and who did not have the cleared land or improved pastures felt that they were justified in burning to keep the brush from killing out what grass there was in the woods. As far as they were concerned, it was a question of choosing the lesser of two evils—either burn and obtain some forage even though it be poor in quality or not burn and still have less forage.

The attitude of foresters, fire-control officers, and others interested in reducing uncontrolled burning has a great deal to do with their success. For example, those who derive, or think they derive, some direct benefit from burning, even though it be only temporary, do not believe foresters and others when they make blanket statements that all fires are bad and that no benefits are derived from burning. This, in turn, may cause them to question the validity of the rest of the conservation program. Time spent in learning the philosophies, the likes and dislikes, and the needs of the local people and in working out ways of approaching them to gain their confidence will pay big dividends in the long run.

Although there are still many who sincerely believe that they are justified in burning, the number is gradually decreasing. Many have discontinued promiscuous burning and are annoyed when their woods are burned by fires set by others. Many are requesting that organized fire protection districts be extended to include their areas. In some cases independent, volunteer fire-fighting units have been organized. This progress can be speeded up by providing additional information and demonstrations on the harmful effects of fire and most of all by showing those who persist in burning how they can keep down the sprouts, provide adequate forage, and otherwise increase their income without burning.

Fire control and grazing and hunting regulations in a region where the people highly value their individuality and independence is considered by many as government meddling into their way of life. Although some have accepted the programs in good faith, others, usually small groups of individuals or families, have vigorously resisted, even to the point of setting more fires. Most of these people cannot be reached by the usual prevention means. They must be handled one at a time and usually by a method which is peculiar to the individual case. A great amount of resourcefulness, patience, understanding, and firmness will be required to meet these situations.

Suppression

Until indiscriminate fire-setting is stopped or greatly reduced, considerable money and effort will be needed to keep the area burned to an acceptable minimum. Prompt, adequate action on fires to put them out while they are still small is of primary importance in keeping the area burned and costs at a low level. This is particularly true in the Ozarks where loose, continuous fuel and rough topography are conducive to a high rate of spread. The chances of fires starting and the inflammability of fuel are greatest in the spring and fall months but vary greatly from day to day and year to year. To get the best results strength of the fire-control organization must be geared to the severity of burning conditions, the fuel types, and the anticipated risk.

The problems of suppression are largely those of determining which factors affect burning conditions and fire behavior, the nature and extent of their effects, methods of measuring and describing the factors and their effects, and evaluating them in a way that will provide bases for planning prompt and adequate action programs for the various conditions that may be encountered in the various parts of the region. Some of the more important factors to be considered are type, amount, arrangement, and moisture content of fuel; type and density of vegetative cover; slope and aspect; season of year and time of day; wind velocity and direction; temperature; humidity; and precipitation. When these factors have been evaluated, as many of them as possible should be combined into an accurate, readily understood meter for indicating the seriousness of the fire situation.

Although considerable progress has been made in increasing the efficiency of actual fire-fighting, there are still many problems to be solved on size and organization of fire-fighting crew transportation, communications, type of equipment, and techniques that will result in the most effective control in terms of costs and accomplishments.

The acreage burned within the protection districts varies considerably from district to district and from year to year. These variations may be the result of differences in the number of fires set, burning conditions, or control programs. A method or yardstick is needed by which the effectiveness of fire-control programs can be evaluated after the differences in the other factors have been taken into consideration.

The goals of fire control (percent allowable burn) will have to be re-examined periodically and adjusted as necessary. Until more information is available on costs of protection, values protected, and values destroyed by burning, it will be impossible to work out realistic cost-benefit ratios or know when the protection program has reached the point of diminishing returns. In the meantime, what bases should be used for setting up goals? In certain areas costs can rightly be disregarded until "hot spots" are eliminated. The forest stands in some areas are more valuable than others and are damaged more by burning. Is it feasible to vary the goals from place to place according to the types of stands involved? Another question in setting up goals is, Will money and effort available for protection buy more by providing intensive protection on a part of the area in need of protection or by providing extensive protection over the entire area? Much of the data and information needed to adjust or set up new goals can be obtained from studies on other phases of the over-all problems. The need for data to provide sound bases for setting up goals should be taken into consideration in planning these studies.

Effects of Burning

Most of the research work on the effects of burning in the Ozarks has been of a very general nature. On the basis of results of these studies and observations, it is generally agreed that burning kills the tops of the reproduction, scars the bases of and often kills larger trees, causes stand composition to deteriorate, prevents the accumulation of litter, reduces watershed protection values, increases the proportion of low value forage plants, destroys recreational values, and prevents full development of the wildlife resource. More specific and detailed information is needed on the extent of these effects and how they vary in different types of stands and under different burning conditions. Similar information is needed on the effects of burning on natural regeneration, succession, soil properties, soil moisture relations, micro climate, tree growth, and on the people and their incentive to grow timber as a crop. More difficult than determining the actual effects of fire is the problem of placing a dollars and cents value on the damages done by fire because of the many intangibles that must be assessed.

Although major emphasis is placed on stopping uncontrolled burning because of its harmful effects, it is possible that properly controlled burning may have some beneficial effects. The main problems to be considered from this point of view are, uses of fire in hazard reduction, as a silvicultural tool, and in the management of forest ranges. Extreme caution must be used in conducting this type of research and in publicizing the results to avoid jeopardizing the current fire-control program.

Diseases and Insects

Diseases and insects are a source of growing concern in this region. Although direct losses, except those caused by decay organisms, have been rather light in the past, diseases and insects are a constant threat to the forest and range resources. The much publicized oak wilt has been found in local infection centers throughout the region. Although it has caused little loss in timber volume to date, the disease is apparently on the increase. The Bureau of Plant Industry in cooperation with other federal, state, and private agencies, is studying the distribution of the disease, methods of transmittal, rate of spread, and methods of control. This work should be intensified.

Decay organisms which enter trees through fire scars, branch stubs, borer holes, and other breaks in the bark destroy a large volume of wood each year. They are responsible for most of the cull trees and the cull portions of the merchantable trees in the present stands. The main problems here are (1) determining the extent and character of these defects in relation to causal organisms and avenues of entrance and (2) developing management methods that will minimize this type of defect by reducing the number of wounds through which the organisms enter.

Pine tip moth and pine sawfly infestations have occurred throughout the region and have reached near-epidemic stages in some localities. The pine tip moth is most severe on young planted stands of shortleaf pine in old fields. Although it seldom kills the tree, it does retard height growth and often results in poorly formed trees. The pine sawfly is most severe on suppressed pine trees. Although some trees are completely defoliated, they usually recover unless defoliation occurs several years in succession. Some progress has been made in controlling these insects by spraying and dusting, but more information is needed on the type of chemicals to use and on the method and time of their application.

Many other diseases and insects, such as little leaf disease of shortleaf pine, nectria and strumella cankers, pin worm and other borers, mineral streaks, twig girdlers, rust on grasses, and bacterial wilt on legumes, are found in or near this region. Provisions should be made to keep a constant watch for the spread of these and other diseases and insects so that prompt remedial action can be taken when necessary.

FOREST MANAGEMENT

Forestation of Bare Lands

Most of the bare lands that may be planted to forest trees are areas strip mined for coal and fields that have been farmed for a number of years after removing the forest cover and then abandoned. Although the problems are of the same general character on both types of land, they are more numerous and more complicated on the stripped lands. Establishing a tree cover on these lands is made more difficult by the rough topography, the large number of stones on the surface, and the extreme variability of the banks resulting from the mixture of soil material and rocks from the various strata above the coal.

Some 15 tree species are now under test on various types of banks. Some of them have been quite successful, some have been failures, and all have been quite variable. Weather conditions, quality of planting stock, and specific soil conditions are the main factors causing the variations. These studies should be continued and expanded to include other species and species mixtures, a wider range of climatic conditions, and specific distinquishable bank conditions.

Although survival and early growth rate are important in establishing a cover, they are only the first step in testing the feasibility of growing timber on these lands. Since these banks are relatively new and untested forest sites, the studies will have to be continued throughout a complete rotation to obtain information on the growth rate that can be expected and the kind and quality of products that the trees will yield.

Most of the problems in the planting of upland fields within the present range of pine have been solved. It is generally agreed that shortleaf pine is the best species to plant, and present methods of stock production and method and time of planting assure satisfactory survival. For the rest of the old fields problems of selecting species, mixtures of species, and methods of planting still need additional study. Some over-all problems still to be solved include: spacing; fall planting; hardwood stock grades; production of quality planting stock; care of planting stock prior to planting; seed collection, care, and treatment; weed control in the nursery;

and, finally, the economic justification for planting on the various types of sites.

Optimum Stand Structure

Before proceeding too far in managing the forests, many decisions should be made and questions answered regarding the kinds of stands and trees that should be grown on the various sites in the different parts of the region. The more important of these questions and decisions have to do with:

1. The tree species and forest types that can be grown on each type of site.

2. The forest type or combination of species that is best from the standpoint of volume, quality, and kind of products they produce.

3. The stocking and the size and age class distribution that will yield the greatest amount of the products desired.

4. The age and size at which trees of various species reach physiological and economic maturity on the various sites.

5. The extent to which volume production should be sacrificed for quality production.

6. The extent to which stand composition and structure should be dictated by existing markets and the need for meeting demands for various products.

Since the trees in the present stands have grown during a period of misuse, it will be necessary to find out to what extent they are representative of those that will be grown under management. In other words, to what extent can research results obtained by studying present trees be applied to trees in managed stands of the future?

Rebuilding the Low-Grade Forest Stands

Since the yield of the forests in this region is only about one-fifth to one-third of their potential, much work and time will be required to make them fully productive. The problems of rebuilding these forest stands are largely those of increasing the stocking of sound trees of good species, keeping them in the stand until they reach economic maturity or until they should be removed for the benefit of the stand, finding which of the existing trees are worth keeping as growing stock, getting rid of the cull and the low value trees, and finding and eliminating the causes of the defects in the trees.

In most cases it is not too much of a problem to maintain a forest cover of some kind. The mere existence of present stands after years of misuse and attempts to clear the land is ample evidence of the persistence of the forest cover. However, obtaining stands with proper combinations of species and size class distributions are likely to be real problems.

Fortunately, natural succession is generally toward a better composition. In other words, if uncontrolled burning, overcutting, overgrazing, and other misuses are discontinued, the forest will improve. However, under some circumstances this natural process may be too slow to produce optimum stands in a reasonable time. This is particularly true where the seed source of desirable species is inadequate, where competition by cull and low value overstory trees and dense stands of sprout reproduction of noncommercial species is severe, and where litter has acculated to unusual depths.

Studies now in progress indicate that where there is an adequate seed source within the present range of shortleaf pine, satisfactory natural regeneration of pine can be had by overhead release alone or in conjunction with ground preparation. The number, type, size, and distribution of seed trees needed to supply an adequate seed source are yet to be determined. The methods of increasing the stocking of pine in low-grade stands by planting and overhead release have been worked out fairly satisfactorily. Preliminary results of other studies indicate that direct seeding of pine may be used as a supplement to planting. However, many details are still needed as to methods and time of seeding and limitations as to site. The costs and returns of such work for various sites will have to be determined before it will be possible to know under what conditions speeding up natural regeneration and artificial regeneration of pine can be justified on an economic basis.

Providing adequate natural regeneration of desirable species of hardwoods and cedar presents many unsolved problems in regard to seed source and supply, seedbed preparation, competition by overstory trees, sprouting, relative height growth rates, direct seeding, planting stock specifications and production, methods and time of planting, and costs and returns.

Since many of the trees in the present stands are defective, the extent to which they can be depended upon to yield merchantable products must be determined. Are the sapling- and pole-sized trees a good framework on which to add more wood? What kind of products will they produce? To what extent can they be improved by pruning and other stand improvement work? Are the trees now of merchantable size worth keeping in the stand for additional growth? How defective are they and at what rate is the defect spreading? Poor form, knots, and decay resulting from organisms entering through fire scars and branch stubs are the principal causes of defect in the trees in the present stands. The extent to which fire control, more dense stands, and pruning will eliminate these defects in the next stands is in need of study.

Many of the trees, about one out of three, have no present or potential market value by present standards. These trees are occupying space that could be used by other, more desirable trees, are slowing the growth of other trees, and must be eliminated if a full stocking of good trees is to be obtained. Since there are no markets for these trees, it is a question of leaving them in the stand, developing new uses and markets for them, or spending money to get rid of them. The possibilities of marketing them will be discussed under the heading "Utilization and Markets." Much progress has been made on the techniques of cutting, girdling, and poisoning as a means of eliminating these trees and keeping subsequent sprouting at a minimum. The economic feasibility of removing these trees is yet to be determined. To do this it will be necessary to obtain accurate information on the costs of various methods and the value of the benefits derived therefrom under the various conditions that exist in the region.

While these stands are being rebuilt, it will be necessary to modify the harvesting methods so that a greater proportion of the good trees will be kept in the stands as growing stock. This will mean that the total harvest either must be reduced or must include more of the low-value trees which should be removed to make room for better trees. From the economic standpoint, it will be necessary to know the extent to which the present stands can be made to pay their way while being rebuilt, the cost-return relationships of managing these stands with and without stand improvement work, and the possibilities of providing adequate financing for rebuilding the stands.

Managing Well-Stocked, Second-Growth Stands

Once the stands have been rebuilt to a satisfactory stocking and composition, they should be managed to provide a continuous and maximum yield of the type of products desired. The problems then are largely those of finding methods of harvesting the timber that will provide complete, wise utilization yet maintain an adequate growing stock and finding out the costs and returns of the various methods of harvesting.

The much discussed questions of whether stands should be managed as all-aged or even-aged stands, on an individual selection or group selection basis, and on long or short cutting cycles are pertinent for most of the stands in this region. Although most of the stands contain two or three age classes, this is the result of past treatment and does not necessarily reflect optimum conditions. However, results of current studies on natural and artificial regeneration of shortleaf pine indicate that some type of even-aged management may be necessary to get adequate natural regeneration of this species.

Some of the more important specific questions on the management of these second-growth stands are: How often should stands be thinned to maintain satisfactory growth? How often can they be thinned for operable quantities of commercial products? To what extent will the products cut in thinnings and other intermediate cuts carry the costs of managing the stands until the final crop is harvested? How early in the life of a stand can it be thinned and still have the harvested products pay for the thinning? To what extent are precommercial thinnings, the elimination of other non-merchantable trees, and pruning justified? Will it be possible to develop a simple and usable tree classification to facilitate the selection of trees to be cut and trees to be left? What method of harvest cutting will provide sufficient natural regeneration to perpetuate stands of desired stocking and composition on the various sites?

Answers to most of these questions will require information on costs and returns, as well as on growth and quality of the trees. It will thus be necessary to find out the relative costs of the various phases of growing, harvesting, and processing forest products and to determine how these costs are affected by type of products, size of trees, volume of material per acre, frequency of cut, accessibility, and location.

Utilization and Markets

One of the big obstacles to good forest management in the region is the difficulties encountered in complete and wise utilization of the trees that should be removed from the stands to keep them productive. This is a particularly big problem now because of the large amount of low-quality material in the forest, and it is likely to continue to be a problem in the future because even managed stands contain some low-quality material that is hard to dispose of at a profit. The problem is further complicated by the fact that it is not always possible to use a tree for the highest-value products it can produce because there is not always a ready market for some products, particularly in small quantities.

What are the possibilities of developing new uses for the sound wood in cull trees, blackjack oak trees, small trees that should be removed in thinnings, short sections of tree trunks, tree tops, and other wood that is not now merchantable? What are the possibilities of making some of this wood marketable by lowering production costs through the use of improved machinery, methods, and techniques of handling forest products? Such improvements would also be available for handling other forest products and thereby increase the profits that could be obtained from them.

What is the possibility and advisability of setting up new wood-using industries in the area, not only to make more complete use of local timber, but also to provide for a greater amount of local remanufacturing and fabrication? If such industries could be established on a sound basis, they would facilitate the growing, harvesting, and selling of forest products, and make it possible for local communities to receive a greater share of the employment and profits derived from the forest enterprises. Post treating plants, pole peeling and framing plants, flooring mills, furniture factories, pulp mills, complete cooperage plants, handle factories, feltwood plants, and wood molasses, alcohol, and other chemical extraction plants are a few of the possibilities that should be considered.

RANGE MANAGEMENT[3]

Livestock, particularly cattle, provide most of the cash income for many Ozark families. Although there are some economic ranch units in the region, most of the livestock is owned by subsistence farmers and woods workers. Small land ownerships, low soil fertility, steep topography, low year-round forage production, and the persistent encroachment of the forest are not conducive to the development of economic-sized, prosperous ranches.

Range management problems are numerous and diversified and often are so closely associated with forest problems that the two must be worked out jointly. Problems of land-use conflict especially need the joint approach. Most of the more important range management problems in this region are presented under the following headings:

Range Resource Appraisal

Plant Control

Revegetation and Management of Old Fields

Management of Forest Ranges

Management of Glade Ranges

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[3] A separate and more detailed analysis of Ozark Range Problems is being prepared and should be ready for distribution in the near future.

Range Resource Appraisal

Since a detailed appraisal of range types and conditions has not been made, one of the primary range research problems is to determine the amount, distribution, and the relative carrying capacities of the more important Ozark range types. Too much of the range information now used is either very general or is based on much less factual data than is desirable.

Most Ozark ranges are forested and are managed primarily for timber production. Consequently, more and better information is needed concerning the yield and quality of forage that is produced under each of the many Ozark forest conditions. The basis for most of the controversy between livestock and forest interests is the fact that the forage yield is much less in dense timber than in poorly stocked forests or in open areas. As a result, a very important question in the management of Ozark forest ranges is, What is the minimum carrying capacity, or the maximum acreage per cow, that will permit profitable cattle production?

Very little basic information is available on Ozark range plants. Before the more practical range management problems can be solved, it will be necessary to get more information on such items as the species which make up the bulk of the usable forage in each forest range type; methods of identifying important species during all stages of development; the relative importance of each species during each season; the relative palatabilities and nutritive values of the important species at different times of the year; and how close each species can be grazed in different seasons without injury. Information of this type will help determine the proper carrying capacities and seasons of use for forest range types.

Plant Control

"Fighting the sprouts" probably takes more time than any other so-called range improvement practice in the Ozarks. The common methods of sprout control are goating, chopping, girdling, and burning. These methods are, for the most part, ineffective and harmful to the site and, except for burning, all are expensive in terms of the labor and time required to do an acceptable job. Perhaps the effectiveness of these methods can be improved. For example, fire, the easiest of all methods, might be more effective and less destructive if used at the right time and properly controlled. Also, goat raising might be moderated and used with other classes of stock in such a way that the goats would help keep weeds and sprouts down without serious damage to forage plants and at the same time return a profit to the owner.

The use of newly developed chemicals offers great possibilities for solving some sprout-control problems. However, before these herbicides are put into general use, more specific information will be needed on the effectiveness of the different chemicals when applied at different seasons of the year at different times of day, in various types of carriers, by different methods, and at varying concentrations and rates. It may be feasible to use some of these chemicals in conjunction with present control methods.

Grasses of little or no forage value and other unpalatable herbaceous species are another important plant control problem on range lands and on pastures that are too rough to till. Selective herbicides show little promise for these plants because herbicides which will kill broomsedge, for example, will also kill the better forage grasses, and the herbicides that will kill broadleafed weeds will also kill palatable legumes. The possibilities of controlling unwanted herbaceous plants by improved grazing practices and other indirect means should ultimately be investigated.

Revegetation and Management of Old Fields

The "crowding in" of the forests following protection against fire is reducing the amount of forage available in forested areas. As the amount of forage in the forest declines, more and more grazing pressure is put on the old fields and other openings. In order to prevent serious overgrazing of the remaining forage resource, the number of livestock must be reduced or the carrying capacity of the open areas increased. Since most of the stock in the Ozarks is considered "essential," attention should be directed to providing additional forage, especially on the old fields.

The broad principles of pasture development on the better sites are fairly well established, but many questions remain to be answered for the less productive Ozark sites. More information is needed on species combinations; methods, dates, and rates of seeding; ground preparation; and the use of lime and fertilizers.

Questions of management of old fields include: What proportion of the total range forage is produced on the old fields and other openings? If these non-forest areas are properly managed and improved, will they supply the forage needs of the area? How close can a pasture be grazed at different seasons without injury? How early in the spring and how late in the fall can grazing be permitted? What effect will different seasons and intensities of grazing have on weed and sprout control problems? How often will soil and seeding treatments have to be repeated? And, Will pasture development pay?

Besides the use of improved tame pasture species, the possibility of improving old fields by using native grasses should also be studied. Improved pasture species, established by adding large amounts of soil minerals, usually are more palatable than native forage. Such improved old fields constitute an acute management problem on unfenced ranges where cattle tend to leave all other forage and concentrate on the improved fields to the detriment of both the livestock and the pasture. Planting old fields to native grasses which are about equal in palatability to the general run of native forage might increase the forage supply without unduly complicating management.

Management of Forest Ranges

Grazing in the forests is a highly controversial subject. The main differences of opinion are over the amount of indirect and direct damage that results from grazing the forests and the value of and the need for the forage in forest stands. The most serious indirect source of damage is woods fires which are set to open up the forest so more grass will grow. Certainly these fires harm the forest. Also, few will question that overgrazing often results in some direct damage from browsing and trampling. However, there is little agreement and no factual information on the amount of direct damage livestock do if the rate of stocking is in accordance with the forage supply.

Exaggerated estimates of the carrying capacity of woods range, together with failure to distinquish between grazing and overgrazing, are responsible for the rather widespread contention that cattle grazing and forestry are always incompatable. Farmers are inclined either to overestimate the value of woods forage or to disregard the possible effects that severe overgrazing may have on the trees. Consequently, most forest grazing, especially on fenced woods, is actually severe overgrazing. Under such conditions the forage species are soon consumed, and when they are gone, livestock have no choice but to browse the trees or starve. Usually they do both. It is probable that in most of the cases of so-called "grazing-damage" to the forest, the damage to the livestock and to the forage plants has been far more serious than the damage inflicted on the trees.

Perhaps the most important reason technical foresters and agriculturalists rate Ozark range so low is the result of trying to apply production and carrying capacity standards for improved pasture to unimproved, wooded range. It is difficult for the technician, with a background of experience in areas where one or two acres of good pasture will carry a cow, to realize that cattle raising can be profitable on ranges where 25 or more acres are required to carry a cow. The profit per acre from 25-acre-per-cow land is likely to be low, but per-acre income alone is not always a reliable measure of ranching profit. Many western cattlemen have five-digit incomes derived from cows that graze entirely on 30- to 70-acre-per-cow land. However, prosperous ranching on lands of low carrying capacity requires such large acreages that few, if any, such operations are likely to develop in the Ozarks where the average land ownership is only 150 acres. Also, extensive ranches are unlikely in the Ozarks because the 40-inch rainfall makes possibilities for increasing forage production so good that most of the tillable areas in the region will eventually be developed into improved pasture. In the meantime, many subsistence operators will continue to derive meager earnings from cattle that graze in the woods where the carrying capacity is very low.

Before the forest-range conflict can be resolved, it will be necessary to obtain more information on such factors as the total amount of overgrazed forest range, where it is, and whether or not it is limited mainly to areas where stock are confined or to areas around water, salting places, old fields, and other natural concentration points. Criteria are needed for determining whether or not an area is overgrazed; whether serious browsing damage on trees occurs before the herbaceous plants are overgrazed; the value of forage in good, fair, and poorly stocked forest stands; where dual use is feasible; and where forest and range use should be separate. Also, the efficiency of raising cattle on a large area of poor range should be compared with that of growing cattle on a small acreage of improved pasture.

Running hogs in the forests is another controversial subject and the points of difference are about the same as those concerning cattle grazing. How much damage hogs do by eating forest tree seed and rooting up tree seedlings or how much hogs help natural regeneration by seedbed preparation resulting from rooting are not known. Authentic data are needed on the value of the mast crop as hog feed and the dependability of the mast crop from year to year. Other problems include losses resulting from poor nutrition, predators, poisonous plants, diseases, parasites, and lack of care. These and many other questions will have to be answered before an intelligent decision can be made as to the advisability of running hogs in the woods.

Management of Glade Ranges

The "glades" are the best natural range land in the region and provide better opportunities for permanent livestock operations than any other area. A few individuals have successfully developed some of these glades into economic ranch units, but many problems will have to be solved before the glades are made fully productive. These range problems differ somewhat from those in other areas in that they have to do with a natural grass area and the "grass versus trees" problems are not so important. The possible invasion of portions of the area by redcedar is the only problem of any consequence in this connection. Also, the shallow, stony soils and the rough topography are for the most part unsatisfactory for cultivated crops and improved pastures. It is generally agreed that range is the proper use of these glades; however, the rough topography, small ownerships, and the intermingled forest stands on the lower slopes and the higher ridges are a handicap in developing large, economic ranch units.

The range problems in this area are largely those of appraising, improving, and managing the range resource. Some of the more important specific problems on which more information is needed are the present and potential carrying capacities for the different seasons of the year; criteria for determining which range sites are usable; palatability and nutritive value of the native grasses--little bluestem and its associates; use of lime and fertilizers to increase yields and palatability; possibilities of introducing new species to provide year-round forage; methods of providing more uniform use of the range forage to prevent overuse and development of "sore spots" on the more desirable portions of the range; classes of livestock and herd composition which are best adapted to the glade range; maintaining uniform weight gains throughout the year; minimum standards of supplemental feeding; and preventing losses from parasites, predators, and diseases.

GETTING RESEARCH RESULTS INTO USE

Research results and other information are of little value unless they are used. Getting the results of forest and range research work into practice may turn out to be as big a problem as getting the results. A very small proportion of the forests in this and other areas are being managed according to best known practices. Many owners make no pretense of managing their forests. They take what they can get and let the future take care of itself. Many are not acquainted with the existing information on forest and range management. Some have wrong information and are doing their forests more harm than good in their attempts at management. Some have not been able to overcome an inherent resistance to changing their way of doing things. Still others are interested in managing their forests as a crop and are fairly well up to date on methods, but are unable to carry out their wishes because of the lack of manpower and finances or hesitate to do so because they are not sure it will pay. Finally, there are some--and the number is gradually increasing--who are managing their forests according to best known practices. These owners are good salesmen for good forest and range management.

The solution to the many problems in getting research results into practice will no doubt require the assistance of specialists in other fields. However, this phase of the work can be greatly facilitated by publishing results promptly in a form readily understood by potential users and by planning field studies so they will be usable as visual demonstrations. These demonstrations should provide a place where forest owners, users, and administrators can go to observe good forestry in practice under conditions similar to their own; a place where they can talk with the men who did the work and get first-hand on-the-ground information on methods, equipment, costs and returns, and the encouragement, advice, and general guidance so essential in handling their forests and ranges.

PRIORITIES AND SELECTION OF FIELDS OF WORK

Solving the forest and range problems in this region is a much bigger job than can be handled with present facilities. It is therefore highly important that state, federal, and private forest and range research work be expanded as rapidly as possible, and more important yet, that all the work be coordinated and integrated to the fullest extent possible so there will be no loss of effort through misdirection and unnecessary duplication. It is equally important that research efforts be directed at those phases of the work that have highest priority.

The research program for this Center must be planned to make the best possible use of available research funds and facilities and at the same time provide a suitable framework for an expanded program when it becomes a reality. Provisions must be made for keeping abreast of the over-all situation, for taking advantage of all opportunities for cooperative work with others, and for working on unforeseen problems that may develop. However, the program should provide for concentrating the work as much as possible to avoid the common failing of attempting to work on too many problems and not doing a thorough job on any of them.

The planning of a research program is made more difficult by the uncertainities of appropriations from year to year. Last year's appropriation of approximately $30,000, supplemented somewhat by contributed cooperative funds, was enough to employ five technical men, one nontechnical man, a clerk-stenographer, and a limited amount of temporary local labor. It also provided the bare essentials in the way of supplies, equipment, and operating expenses. Available assistance and counsel of specialists and free use of office space, laboratories, and equipment greatly facilitate the work and make it possible to use a greater part of available funds for salaries of research personnel.

The problems of fields of work discussed in the preceding section have been summarized in table form on pages 46 to 51. In this table an attempt has been made to rate the problems as to their over-all importance in the region and their priority for inclusion in the research program from the standpoint of present conditions, research organization and facilities, and studies now in progress. This, of course, may mean that some problems may be rated high in importance but low in priority because present facilities are inadequate to undertake the work. Conversely, some problems considered medium or low in over-all importance may be rated high in priority because funds available for research have been earmarked for them by Congress or the cooperator. In this connection, portions of funds now available to this Center must be used for research on forest management, range management, forestation of strip-mined lands, fire control, and special marketing problems. Occasionally, unforeseen situations arise which make it possible and advisable to take advantage of special opportunities to start new studies or collect data on special phases of work. Although these studies will, in most cases, be of short duration and will not take too much time, provisions must be made to take advantage of such situations.

LAND-USE CLASSIFICATION

The present uses of land are dictated more by needs of the owners and users than by land characteristics and capabilities. Even though this situation is likely to exist for many years, the problems of land-use classification are important and must be worked out eventually. However, since there are large areas of low-value forests on land for which forestry is generally agreed to be the best use and a large number of old fields which could produce more needed forage, it seems logical, for the present at least, to concentrate on improving these forests, pastures, and other uses as a means of making the lands more productive. Furthermore, much of the basic information on the costs and returns that can be expected from different uses of the various types of land can best be obtained from forest and range management studies. The problems of land-use classification as such are therefore assigned a low priority and research on these problems in the near future will be limited to those phases that can be worked out in conjunction with other planned research work.

PROTECTION

Uncontrolled Burning

Large amounts of time and money are used each year in an effort to reduce the amount of uncontrolled burning in the Ozarks. Research to solve the fire problems and increase the efficiency of the fire-control program is considered very important. This is shown by the fact that public fire-control funds are now being allocated to this Center to help finance a one-man fire research project.

The problems to be solved are fairly well known and agreed upon, but their relative importance and their priority for research are yet to be determined. The rating assigned in the table on page 46, should, therefore, be considered tentative. They may be confirmed or changed when the detailed fire problem analysis is completed.

The fire research program cannot be planned beyond the end of this year until the fire problem analysis is completed. Preparation of the analysis will be given top priority until it is completed. During the fire seasons as much time as possible will be spent with fire-fighting crews to become acquainted with burning conditions, rates of spread, resistance to control, crew organizations and techniques, and fire effects. The fire records for the region will be examined as a first step in checking the adequacy of the existing fire danger meter and to obtain leads on ways in which it may be improved.

Diseases and Insects

Federal investigations on diseases and insects are for the most part the responsibility of other bureaus and should not receive high priority consideration in this program. However, all personnel should be on the alert at all times for evidence of new disease and insect attacks that should be investigated. Provisions should also be made to cooperate in working out methods of management that will keep insect and disease losses at a minimum Methods of managing the forests to reduce losses from decay by decreasing the number of stubs, knots, fire scars, and other entry points for the decay organisms are very important in this region. The Department of Forestry at the University of Missouri is now working on this problem. In the Center program this work is given a medium priority and will be carried out as a phase of other forest management research.

FOREST MANAGEMENT RESEARCH

Forestation of Bare Lands

Because of the large acreage already in forests and the apparent need for cleared land for forage production, the forestation of old fields in this region is not being agressively pushed at the present time. Even lands on which forestry is obviously the best long-time use are left clear if there is a definite present or anticipated need for the forage being produced there. Too often, if trees are planted on an old field when the need for forage is not urgent, another area is cleared a few years later when the need for forage or crop land increases.

Although there are several hundred thousand acres that may eventually be returned to forests, it seems logical to concentrate on bringing the existing forest lands to more nearly full production. For this reason, forestation of old fields is rated as low in priority for research work. Except for taking advantage of special opportunities to get data on certain phases of the work, no research on forestation of old fields is contemplated for at least the next few years.

Part of the forest management funds allocated to this Center are for investigating the feasibility of establishing a forest cover on the 70 to 75 thousand acres of spoil banks in the Western Interior Coal Province. Funds available for this work last year were sufficient to cover half of the salary and expenses of one man. Although the stripped lands are a relatively small proportion of the area, there is a wide interest in their reclamation. The problems of establishing a tree cover on them are unique and rather complicated and are assigned a high priority for research.

Work on this project during the next few years should include:

1. Publishing reports on the location, extent, and chemical and physical characteristics of spoil banks in the Western Interior Coal Province.

2. Continuing investigations on (a) adaptation of forest tree species to spoil bank conditions, (b) determination of distinquishing characteristics of sites suitable for planting, (c) the feasibility of leveling spoil banks prior to planting, and (d) improving the quality of black walnut by pruning.

3. Planning and initiating studies to find out if it is feasible to use locust and other easy-to-establish species as nurse crops for higher-value species, such as black walnut, which are more difficult to establish.

Managing Forest Stands

The problems listed under "Optimum Stand Structure," "Rebuilding Low-Grade Forest Stands," and "Managing Well-Stocked, Second-Growth Stands" are closely interrelated and can best be considered together. They are all very important in this region and all but a few of them would rate a high priority for research work if it were possible to expand the research program. The selection of the general field of work is not too difficult, but the selection of the particular problems or phases of problems on which to start studies is both difficult and discouraging because it means postponing some work that should be started right away.

The general field of work can, by the process of elimination, be narrowed to the oak-pine forest type without much difficulty or question. The farm woodlots, the bottomland forests, and the mixed-mesophytic forests make up a small proportion of the total forest area. Research in these types is included in the research programs of Research Centers in Iowa and Illinois, and the State Agriculture Experiment Stations The cedar-hardwood type also represents a small proportion of the total forest area and problems of this type are being considered by a branch of the Southern Forest Experiment Station in Harrison, Arkansas. Since many of the findings will, with a limited amount of testing, apply to similar forests here, it seems logical that work in these types be postponed until a later date. The elimination of these types in no way minimizes the importance of the types in the areas in which they occur or the need for research work; it simply means that they rate a lower priority at this time, at this Center.

This leaves the oak-hickory and the oak-pine types, which make up by far the largest part of the forested area. Since the oak-hickory type is similar to the oak-hickory phase of the oak-pine type, some of the results of research in the oak-pine stands should be applicable to the oak-hickory stands, particularly those within the present range of pine. Also, young stands of the oak-pine type deteriorate from lack of proper management at an earlier age than other stands, can be managed by commercial harvest cutting at an earlier age, afford greater opportunities for increasing forest production, and receive more interest and respect from the local people. It therefore seems logical that forest management research at the Center for the next few years concentrate on solving the problems of the oak-pine type which in this report is interpreted to include the intermingling oak-hickory stands.

Providing adequate stocking of pine in stands within the present range of pine offers good possibilities for increasing the productivity of these stands and rates high in over-all importance. The problems encountered in accomplishing this also rate high in priority for research, particularly completing and publishing the results of studies on converting low-grade oak stands to oak-pine stands by planting, direct seeding, and overhead release. These studies, started during CCC days, will provide much usable information. Finding out to what extent increased yields from these converted stands will justify the costs in various types of stands on different sites is also quite important and will be included in the research work in managing fully-stocked natural and planted stands.

Rebuilding and managing oak-pine forest stands is one of the major fields of work that should receive high priority consideration by this Center in the near future. The major part of forest research work should be aimed at solving the following three closely related and interdependent problems:

1. What is the optimum stand structure and composition on the various sites?

2. What is the most economical method of securing these stands?

3. Once the stands have been rebuilt to full production, how should they be managed to make the best use of wood produced and at the same time assure perpetuation of the desired stands?

Efforts during the next several years should be devoted to (1) completing and publishing results of studies now under way on the methods of increasing the stocking and growth rate of pine in low value oak-hickory stands within the present range of pine and (2) planning and conducting studies in the oak-pine type. The studies should determine (a) the proportion or pine that should be maintained in the stands to yield the greatest returns; (b) the number of trees of different sizes that should be grown on each acre to maintain an optimum growth rate; (c) the relative merits of managing the stands on a short and long rotation; that is, harvesting the trees while relatively small for small products, such as posts, poles, ties, or growing the trees to larger sizes for such products as saw logs, veneer logs, and bourbon stave bolts; and (d) the effects of these methods of management on natural regeneration.

Utilization and Markets

Facilities and equipment for doing forest products research work are not available and are too expensive to acquire with present finances. This means that work on such things as new uses of wood, uses of low-grade materials, chemical treatments, and extractions, should be referred to the Forest Products Laboratory, the Utilization Service of the Central States Forest Experiment Station, and the State Agriculture Experiment Stations that are doing or planning to do work in this field. Some marketing research, financed by a special contribution from the Missouri State Division of Resources and Development and special funds under the Research and Marketing Act of 1946, is now in progress. Also, under another section of this Act, funds can be made available for cooperative marketing research work with State Agriculture Experiment Stations and other agencies. For these reasons, work in utilization and markets, except as provided for by special funds, is considered low priority in this program.

Unless additional cooperative funds or special appropriations are forthcoming, the work in this field will be limited to the completion of the cooperative "Pine Resource and Marketing" Project which is now in progress.

RANGE MANAGEMENT RESEARCH

Range research is relatively new in this region. Consequently, plans for the research program will be greatly influenced by the need for basic information on identification and evaluation of range species; the extent, distribution, and value of the principal range types; and the importance of livestock production to the general economy of the region. This information is needed not only for the proper management of the resource but for the planning of the rest of the research program. Studies to obtain this information are therefore given high priority for research.

The problems of controlling sprouts are very important because many livestock owners wage a constant fight against sprouts and brush to keep them from interfering with the growth of forage. Present methods of control are for the most part ineffective or provide only temporary control and usually result in some direct or indirect damage. The possibilities of controlling the sprouts with the newly developed chemical herbicides rate high in priority for research.

The development of improved pastures on old fields is very important in this region. Because research in this field of work is the responsibility of other agencies, it has low priority for research at this Center. However, the reseeding and other pasture improvement work being done by the national forests provide opportunities to obtain some much needed information on these problems. The activities of the Center on these problems will be limited to helping plan and evaluate the results of this pasture improvement work on national forest land.

The question of whether or not the woods should be grazed consists of many problems of varying importance. Some of the important ones involve, directly or indirectly, other phases of work such as land-use classification, fire control, and management of the forests and are rated under those sections. In range research, high priority is given to the problems of finding out the kind, extent, and value of the forage in different forest types and forest stand conditions.

The problems of managing the natural range in the glades section are perhaps the most important of all the range problems and will probably become more important in the future. Since there is no conflict in land use involved, the important problems are largely those of evaluating, improving, and using the forage on the range. Evaluating and improving the forage and those phases of using the forage that can be studied without using livestock have high priority for research. The problems of classes of livestock herd composition, use of forage by livestock, and developing economic ranch units will have to be postponed until the necessary livestock is available.

The range research work for the next few years will include the following:

1. Complete and publish a detailed range problem analysis.

2. Continue sprout-control studies designed to test the value of several chemical herbicides for killing post oak, blackjack oak, and related species.

3. Cooperate with the Clark and Mark Twain National Forests in their range reseeding program by helping plan and evaluate the results of their projects.

4. Plan and initiate formal studies on (a) the identification and evaluation of forest range plants, and (b) methods of increasing the yield, palatability, and nutritive value of the forage on the glade range.

GETTING RESEARCH RESULTS INTO USE

Prompt publication of research results is not only high in over-all importance but also in priority for work at this Center. This is especially true here because of the meager amount of pertinent information on the management of the forest and range resources and the great accumulation of unpublished data from studies started during the CCC program. First consideration will be given to publishing the results of studies on factors affecting the sprouting of blackjack oak and other hardwood trees, effects of overhead release on the survival and growth of planted pine and natural hardwood reproduction, and the possibilities of direct seeding as a means of increasing the stocking of shortleaf pine. The need for providing for prompt publication of results will be given very high priority in planning future research.

Providing demonstrations of important phases of work also rates high in importance and, insofar as possible, new studies will be planned to increase their values as demonstrations. A part of the Experimental Forest has been set aside as a special demonstration area. However, it is not likely that it can be developed to any great extent during the next few years.

MAJOR FOREST AND RANGE PROBLEMS AND THEIR RATINGS AS TO RELATIVE OVER-ALL IMPORTANCE, THEIR PRIORITY FOR RESEARCH, AND THE TYPE OF STUDIES NOW IN PROGRESS

PROBLEMS	Types of Studies Now in Progress: Formal-F, Informal or Incidental-I, None-N	Priority for Research: High-H, Medium-M,Low-L, Opportunistic-O	Relative Over-all Importance: High-H, Medium-M, Low-L
LAND-USE CLASSIFICATION (Pages 20 and 39)			
Land-use stabilization	N	L,O	M
Present and future needs of land for forest, range, and other uses for sound economy	N	L,O	H
Extent to which good management will meet needs without increases in acreage	N	L,O	H
Effects of different uses on the soil and on soil-water relations	N	M,O	M
Feasibility of converting to other uses	I	L,O	L
Costs and returns from different uses of various types of land at different levels of management	I	L,O	H
PROTECTION			
Uncontrolled Burning (Pages 21 and 39)			
Prevention--finding and eliminating the reasons for burning	I	M,O	H
Effects of fire under different burning conditions on plant cover, soil, watershed, wildlife, and recreation	I	H,O	H
Evaluation of fire effects--damage appraisal	N	M	M
Measurement and evaluation of danger factors for improving danger rating and for preparing other aids in fire-control planning	I	H	H
Developing, testing, and evaluating equipment and techniques	I	M,O	M

PROBLEMS	S	P	I
Evaluating the effectiveness of the control program	N	H	M
Determining fire control cost-benefit ratios by forest types and sites for setting goals and objectives of fire-control program	N	L,0	M
Use of controlled burning as a silvicultural tool in hazard reduction and in range management	N	L,0	M
Diseases and Insects (Pages 26 and 40)			
Extent, transmission, and control of diseases (oak wilt, etc.)	N	L	M
Methods of management to eliminate avenues of entrance for wood-decaying organisms	I	M,0	H
Methods of controlling insects (pine tip moth, pine sawfly, etc.)	N	L	L
Detection of new disease and insect attacks	I	L,0	M
FOREST MANAGEMENT			
Forestation of Bare Lands (Pages 27, 40, and 52)			
Abandoned fields	N	L	L
Strip-mined lands	F	H	M
Selection of species and species mixtures for different sites	F	H	H
Methods, spacing, and seasons of planting and direct seeding	I	L	L
Production and care of planting stock	N	M	L
Costs and returns	I	M,0	L
Forest Types--Over-all Rating of Types for Problems in Next Four Sections (Pages 14, 41, and 52)			
Oak-hickory	I	M,0	H

PROBLEMS	S	P	I
Oak-pine	F	H	H
Shortleaf pine	F	H	H
Cedar-hardwood	N	M	M
Mixed-mesophytic	N	L	L
Bottomland hardwoods	N	L	L
Optimum Stand Structure (Pages 28, 41. and 52)			
Choice of species and combinations of species from standpoint of			
Adaptation to various sites	I	H	H
Volume, quality, and kinds of products produced	I	H	H
The stocking and the size and age class distribution that will provide the greatest yield of the products desired	F	H	H
Age and size at which trees of different species on different sites reach physiological and economic maturity	N	M,O	M
Quality versus quantity production	N	M	M
Extent to which stand composition and structure should be dictated by markets and demands for special products	N	L	L
Rebuilding the Low-Grade Forest Stands (Pages 28, 41, and 52)			
Increasing the stocking of desirable species by			
Natural regeneration	F	H	H
Artificial regeneration	F	H	M
Evaluating existing trees as growing stock	I	H	H
Finding and eliminating causes of defect	I	M,O	H
Methods of eliminating undesirable trees	F	H	H

PROBLEMS	S	P	I
Economics of rebuilding low-grade forest stands	I	M,O	M
Financing the forest rebuilding job	N	L	L
Managing Well-Stocked, Second-Growth Stands (Pages 30, 41, and 52)			
Methods of intermediate harvest cutting	I	H	H
Methods of final harvest cutting	N	L	M
Stand improvement			
Pre-commercial thinnings	N	L	L
Pruning	F	M	L
Costs and returns	I	M,O	M
Tree classification	I	L,O	L
Utilization and Markets (Pages 31, 43, and 52)			
More complete utilization of timber	I	M	H
Utilizing trees for highest value products	I	M	H
New industries for more complete local remanufacture of wood products	I	L,O	H
Marketing wood not now merchantable			
New uses	I	L	M
New markets	F	H	H
Lowering handling costs	N	M,O	M
RANGE MANAGEMENT			
Range Resource Appraisal (Pages 32 and 44)			
Determining amount, estimated value, and distribution of the principal range types	I	M,O	H
Identifying and evaluating forage species	I	H	M

PROBLEMS	S	P	I
Plant Control (Pages 33, 44, and 52)			
Control methods for woody plants	F	H	H
Control methods for broomsedge and other low value herbaceous plants	N	M	H
Costs and returns	I	M,O	M
Revegetation and Management of Old Fields (Pages 34 and 44)			
Establishing and managing native grasses on old fields	N	M,O	M
Establishing and managing tame pasture species on old fields	I	L,O	H
Management of Forest Ranges (Pages 35 and 44)			
Detailed evaluation of forest range types	I	H	H
Utilization of forest range	I	M	M
Appraisal of forest damage by cattle	N	M	M
Possibilities for forest and range use on the same site and on adjacent sites	N	M	L
Economics of cattle raising on forest range as compared with cleared range and improved pasture	N	M,O	H
Benefits and damages from range hogs	N	M,O	M
Livestock parasites and diseases	N	L	L
Management of Glade Ranges (Pages 36 and 44)			
Detailed evaluation of glade range	I	H	H
Utilization of glade range	I	H	H
Possibilities for combining livestock and cedar production	N	M	M

PROBLEMS	S	P	I
Desirable classes of cattle and herd composition	N	M	H
Range reseeding	I	M	M
Use of fertilizers and lime to increase yield and palatability	I	M	M
Use of fire as a range management tool	N	M	M
Correcting nutritional deficiencies by supplemental feeding	N	M	H
Livestock parasites and diseases	N	L	L
Economics of glade range management	I	M,O	M
GETTING RESEARCH RESULTS INTO USE (Pages 37, 45, and 52)			
Overcoming resistance to change	N	L,O	M
Prompt publication of results in a usable form	F	H	H
Increasing demonstrational value of permanent field studies	I	H	H
Providing special demonstrations of important phases of research work	N	M	H

RESEARCH NOW IN PROGRESS

REPRODUCTION RELEASE STUDY

Objectives: The primary objective is to determine the effects of different methods and intensities of overhead release at different times of the year on the survival and growth rate of planted shortleaf pine, on natural seedling and sprout reproduction, and on the establishment and growth rate of new seedlings in low-grade oak-hickory stands. The secondary objective is to find the extent to which sprouts of undesirable species compete with pine and other desirable species.

Variables Under Test: Methods of release--cutting, deep girdling, and shallow girdling. Times of release--March, May, and August. Intensities of release--0, 33, 67, and 100 percent, based on average basal area of overstory trees.

Status: Initiated, 1938. Data on planted pine published, 1946. Last measurement, 1949. Data to be analyzed and results to be published.

PINE PLANTATION RELEASE STUDY

Objectives: To determine the effects of different methods and times of removing the low-grade hardwood overstory on the survival and growth rate of the under-planted shortleaf pine.

Variables Under Test: Methods of release--cutting, (sudden release) and girdling (gradual release). Times of release --at the time of planting, one year after planting, and two years after planting.

Status: Initiated, 1939. Published, 1946. Last measurement in 1947 after fire destroyed one series of plots. Salvage value to be determined.

NATURAL PINE RELEASE STUDY

Objectives: To determine the effects of different methods of removing individual residual hardwood overstory trees on the survival, growth rate, and quality of different sized natural pine trees at different distances from the overstory trees.

Variables Under Test: Methods of removing overstory trees --cutting, girdling, and check. Size of natural pine--1 to 20 feet in height. Distance from overstory trees--1 to 25 feet.

Status: Initiated, 1939. Last measurement, 1943. Measurement to be made, data to be analyzed and results to be published.

PINE SEEDBED PREPARATION STUDY

Objectives: To determine the effects of five types of seedbed preparation and two intensities of overhead release on the establishment, survival, and growth rate of shortleaf pine seedlings in low-grade oak-hickory stands.

Variables Under Test: Seedbed preparation--litter removed by raking, litter removed by raking and soil cultivated, soil cultivated without removing litter, litter removed by burning, and check. Overhead release--none and 75 percent of overstory removed.

Status: Initiated, 1938. Last measurement, 1943. Published, 1945. Retained for demonstration and possible later measurement.

SHORTLEAF PINE SEED-SPOTTING STUDY

Objectives: To find the effects of times of seeding and methods of overhead release on the effectiveness of direct seeding as a means of establishing shortleaf pine in low-grade oak-hickory stands within the present range of pine.

Variables Under Test: Times of seeding--December, February, and March with dry seed and March with stratified seed. Methods of release--cutting and girdling.

Status: Initiated, 1941. Last measurement, 1949. Data to be analyzed and results to be published.

SEED-SPOTTING VERSUS PLANTING STUDY

Objectives: To find the relative survival and growth rates of shortleaf pine when established by direct seeding and by planting in low-grade oak-hickory stands and released by cutting and girdling.

Variables Under Test: Planting materials--seed and one-year-old seedlings. Methods of release--cutting and girdling.

Status: Initiated, 1941. Last measurement, 1949. Data to be analyzed and results to be published.

HARDWOOD SPROUTING STUDY

Objectives: To find the amount of sprouting, in terms of proportion of trees that sprout, number of sprouts per tree, and the size of sprout clumps resulting from different methods of killing the tops of overstory trees of different species when applied at different heights and times of year and under various amount of competition.

Variables Under Test: Methods of killing tops--cutting, deep girdling, and shallow girdling. Heights of treatment--6 inches and 30 inches. Times of year--March, May and August. Competition--residual overstory containing 0. 27, and 54 square feet basal area.

Status: Initiated, 1938. Last measurement, 1949. Data to be analyzed and results to be published.

BLACKJACK OAK SPROUTING STUDY

Objectives: To find out (1) in which month of the year blackjack oak trees should be girdled in order to keep subsequent sprouting at a minimum, (2) if shallow girdling is more effective than deep girdling, and (3) if there is any correlation between sprouting after girdling and certain tree characteristics, such as diameter, crown class, size of crown, and growing condition.

Variables Under Test: Depths of girdling--shallow (peel) and deep (one-half to one inch into sapwood). Times of girdling--each month of the year.

Status: Initiated, 1938. Last measurement, 1944. Data analyzed. Results to be published.

SPECIES ADAPTATION STUDY

Objectives: To test the adaptability, in terms of survival, growth rate, and quality, of several forest tree species to various types of spoil banks.

Variables Under Test: Species--shortleaf, jack, ponderosa, Virginia, loblolly, and pitch pine, eastern red cedar, black locust, green ash, black cherry, black walnut, bur oak and red gum. Spoil banks--Weir No. 6, Mineral No. 9, Croweburg No. 12, Bevier No. 14, and Mulberry No. 18.

Status: Initiated, 1947. Last measurement, 1948. Measurement scheduled for 1951 Publication scheduled for 1952.

SPOIL BANK LEVELING STUDY

Objectives: To test the effects of leveling spoil banks on available moisture and on the establishment and growth of several forest tree species.

Variables Under Test: Spoil-bank surfaces--leveled and unleveled. Species--shortleaf, jack, ponderosa, Virginia loblolly, and pitch pine, eastern red cedar, black locust, green ash, black cherry, black walnut, bur oak, and red gum.

Status: Initiated, 1947. Last measurement, 1950. Measurement scheduled for 1951. Publication scheduled for 1952.

WALNUT PLANTING STUDY

Objectives: The primary objectives are to compare the growth and quality of black walnut on spoils when grown in (a) pure stands; (b) mixed stands of walnut and black locust; (c) mixed stands of walnut, black locust, and four other species; and (d) mixed stands of walnut and the four other species without locust. The secondary objectives are to determine (a) the effects of black locust on the four other species; (b) the early survival of the species used in the study and the apparent cause of mortality; (c) the effects of exposure and topography on tree survival, growth rate, and quality; and (d) the general effects of the various species mixtures on the site, particularly the soil.

Variables Under Test: Species mixtures (percents)--black walnut 100; black walnut 75, black locust 25; black walnut 50, black locust 50; black walnut 20, sycamore 20, green ash 20, bur oak 20, eastern red cedar 20; and black walnut 10, black locust 50, sycamore 10, green ash 10, bur oak 10, and eastern red cedar 10.

Status: Initiated, March 1950. Survival count scheduled for fall 1950. Replant as necessary, March 1951. Survival counts and height measurements scheduled for falls of 1951 and 1954. Publication scheduled for 1955.

WALNUT PRUNING STUDY

Objectives: The primary objective of this study is to find the effects of removing different proportions of the live crown of various sized planted black walnut trees on spoil banks on subsequent height and diameter growth rates and on the development of sprouts on the main boles. The secondary objectives are to find (1) the decay incidence in pruning wounds; (2) the time and the amount of radial growth required to produce clear wood over the wounds; (3) the effects that crown class, crown size, and crown growing space may have on the primary relationships under study; (4) the origin and location of sprouts which develop after pruning; and (5) preliminary estimates on the time required for pruning.

Variables Under Test: Intensities of pruning--0, 25, 50, and 75 percent of live crown removed. Sizes of trees--3, 4, and 5 inches in diameter breast high.

Status: Initiated, January 1950. Measurements scheduled for 1951 and 1954. Publications scheduled for 1952 and 1955.

HARDWOOD THINNING STUDY

Objectives: To determine the effects of different degrees of thinning of second growth oak-hickory stands on the diameter growth rate and the amount of sprouting on the tree trunks of the remaining trees.

Variables Under Test: Degrees of thinning--to basal area of 27, 54, and 81 square feet.

Status: Initiated, 1938. Last measurement, 1949. Data to be analyzed and results to be published.

PINE RESOURCE AND MARKETING STUDY

Objectives: To determine for that portion of the Missouri Ozarks where pine is important (Carter, Reynolds, Shannon, Wayne, Madison, and, if time permits, adjoining counties) (1) the area, location, volume, growth, quality, drain, and ownership of the present pine timber resource that is suitable for such products as pulpwood, posts, poles, and saw logs; (2) the economic feasibility of marketing thinnings and harvest cuttings from the pine stands of this area for pulpwood, poles, saw logs, and posts; (3) the size and kind of forest industries that will make the best long-time use of the pine resource.

Status: Initiated, 1950. Field work to be completed in 1951. Publication scheduled for 1952.

SPROUT SPRAYING STUDY

Objectives: The primary objective of this study is to determine the relative effectiveness of three concentrations of six herbicidal sprays for killing the tops of existing sprout reproduction and preventing resprouting of post oak, blackjack oak, hickory, and associated hardwood species.

Variables Under Test: Herbicides--ammonium sulfamate; butyl ester of 2, 4-D; isopropyl ester of 2,4,5-T; amine salt of 2,4,5-T; propylene glycol ether esters of 2,4,5-T; and a mixture of the propylene glycol ether esters of 2,4-D and 2,4,5-T. Concentrations--0.2, 0.5, and 1.0 percent 2,4-D, and 2,4,5-T; and 10.7, 19.4, and 32.4 percent ammate. Time of day--morning, noon, and evening.

Status: Initiated, June 1950. Measurements scheduled for falls of 1951, 1952, and 1953. Publications scheduled for 1952 and 1954.

SAPLING SPROUT-CONTROL STUDY

Objectives: To test the relative effectiveness of what appear to be the most promising formulations, concentrations, and seasons of applying 2,4,5-T and ammate for killing the tops and roots of sapling-sized trees when applied to the base of the tree trunk.

Variables Under Test: Species--post oak, blackjack oak, black oak, white oak, hickory, and others. Herbicides--ammate, amine, and ester 2,4,5-T. Concentrations--1.0 percent and 2.0 percent, 2,4,5-T and ammate crystals; 32.4 percent aqueous solution of ammate; 32.4 percent aqueous solution of ammate thickened with flour; and check. Carriers--kerosene, and a mixture of 20 percent kerosene and 80 percent water thickened with flour. Season of year --September, December, and June.

Status: Initiated, 1950. Measurements scheduled for the falls of 1951, 1952, and 1953. Publications scheduled for 1952 and 1954.

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